FRAMEWORK FOR THE PLANNING OF THE AREA ALONG THE DELHI-MUMBAI INDUSTRIAL CORRIDOR- "A CASE OF BHARUCH, GUJARAT"

Project Phase-II Report

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Master of Technology
in
Urban Planning

By

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Declaration

I, **Sabeeha Arif**, hereby declare that this thesis, titled *"***Framework for the planning of area along the Delhi-Mumbai Industrial Corridor - A case of Bharuch, Gujarat***",* is my original work, undertaken in the **Department of Architecture and Planning** at Visvesvaraya National Institute of Technology, Nagpur. I confirm that this research has not been previously submitted, in whole or in part, for any degree or diploma at this institution or any other university.

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Date:

Certificate

This to certify that the thesis titled "**Framework for the planning of area along the Delhi-Mumbai Industrial Corridor - A case of Bharuch, Gujarat**" is submitted by **Sabeeha Arif** in partial fulfillment of the requirements for the award of the degree of **Master of Technology in Urban Planning**, VNIT Nagpur. The work is comprehensive, complete and fit for final evaluation.

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ABSTRACT

This thesis, titled *"Framework for the Planning of Area along the Delhi-Mumbai Industrial Corridor – A Case of Bharuch, Gujarat"*, focuses on creating a balanced and practical development plan for a 42 sq. km area in Bharuch district, located along the Delhi-Mumbai Industrial Corridor (DMIC). The aim is to guide growth in a way that benefits both people and the economy, without adding to the existing industrial pressure in the region.

The study starts by examining how better transport connectivity under the DMIC influences land prices, job opportunities, and regional development. Three districts—Bharuch, Vadodara, and Surat—were compared using household surveys and a vulnerability index based on social, economic, infrastructure, and demographic factors. Bharuch emerged as the most in need of focused intervention. The study area was then selected based on regional connectivity, existing settlements, and development potential.

Using GIS tools and Space Syntax analysis, the thesis mapped out how well-connected the area is, and which parts are most suitable for development. This helped identify where to place key activities like housing, commerce, and public services. Gaps in infrastructure, especially in education and healthcare, were also identified through surveys.

Finally, the thesis proposes a set of practical, location-specific strategies—like promoting mixed-use zones, protecting green areas, improving public facilities, and encouraging compact neighbourhoods. The goal is to make the area more liveable, inclusive, and economically diverse. By combining local needs with the opportunities created by the DMIC, the study offers a clear and actionable plan for sustainable growth in Bharuch.

Keywords: Transport Infrastructure, Industrialization, Industrial Corridors, Space Syntax Network Analysis, Land Suitability

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CHAPTER 01
INTRODUCTION

This chapter introduces the conceptual foundation of the study by explaining the relationship between transportation infrastructure, industrial corridors, and economic development. It outlines the research aim, objectives, need, and scope, focusing on how the DMIC project can be a catalyst for planned growth in Bharuch, Gujarat.

Transport systems are both a reflection of economic health and a catalyst for further growth, shaping the way nations progress. Recognizing this dual role, researchers are increasingly focusing on transport infrastructure, exploring its diverse impacts on development, efficiency, and sustainability. Transport is more than a system—it's a key enabler of economic and social vitality (Ejiogu, 2021). Transportation infrastructure is a crucial backbone of any economy, connecting resources, industries, and people. It drives the flow of goods and services, ensuring production factors reach where they are needed most. By enabling smoother logistics and faster connections, it plays a vital role in enhancing industrial efficiency and fostering innovation. This, in turn, supports the growth and transformation of industries, helping economies adapt and thrive in an ever-changing world. Transportation isn’t just about moving things—it’s about powering progress, creating opportunities, and shaping a more connected and productive future (Jingxiao, 2021). Reliable and well-developed infrastructure ensures the smooth flow of goods and services, supports job creation, and fosters regional development. In essence, transport infrastructure is a cornerstone of sustainable progress, bridging gaps and fueling a nation's overall prosperity (Ejiogu, 2021).

1.1 Background of the study

1.1.1 Transportation and Industrial Growth

Transport infrastructure is essential for industrial growth and plays a key role in shaping social and economic progress. Its impact extends beyond connectivity, driving regional development by redistributing resources and improving manufacturing efficiency. By linking industries, facilitating the movement of goods, and attracting talent, it promotes economic growth and population concentration in thriving regions. The benefits ripple

through communities, creating opportunities, boosting productivity, and fostering overall development. In short, transport infrastructure is not just about moving things it's a foundation for building stronger industries, vibrant communities, and a resilient economy. (Ejiogu, 2021)

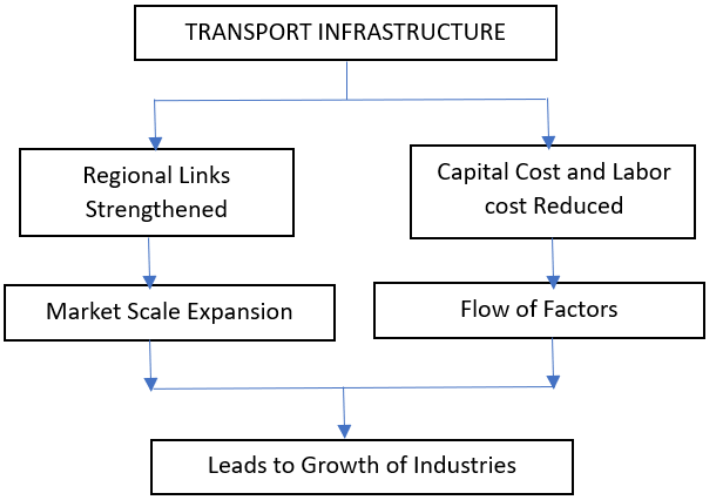


Figure 1: Relationship of Transport Infrastructure and Industrial Growth

1.1.2 Urban Growth and Corridors

Rapid urbanization in developing countries like India has brought significant challenges, putting immense pressure on cities. The unchecked growth has strained natural resources and led to uneven urban development, creating imbalances in infrastructure and quality of life. To address the rising population in urban hubs and ensure sustainable growth, governments and planners are shifting their focus toward regional development. This approach aims to ease the burden on core cities by fostering balanced growth across urban corridors. India is now planning future-oriented urban corridors to promote equitable development, ensuring that progress is inclusive, resource-conscious, and sustainable for generations to come (Chandan Mysore Chandrashekar, 2021).

1.1.3 Industrial Corridor

These corridors aim to boost development by connecting key hubs of trade, industry, and infrastructure. Their success depends on robust infrastructure, efficient corridor services, and effective management. By fostering connectivity and supporting industries, economic

corridors have the potential to transform regions into thriving economic zones, promoting growth, creating jobs, and improving living standards (GW Samsi Gunarta, 2021). By streamlining the movement of goods and services, corridors act as catalysts for regional and national development, paving the way for improved trade, industrial growth, and better opportunities for communities. (GW Samsi Gunarta, 2021)

Industrial corridors create a seamless collaboration between industries and infrastructure, driving both economic and social development. They feature advanced transportation networks, state-of-the-art ports for efficient cargo handling, modern airports, and regions of economic importance. Logistic parks and shipment hubs streamline trade, while knowledge parks address the specific needs of industries. Complementary infrastructure, including townships, real estate, and urban developments, forms a supportive framework that fosters growth. Together, these elements create dynamic hubs of activity, improving connectivity, boosting productivity, and enhancing the quality of life for communities within and around the corridors (Ar. Akrati Sharma, 2020).

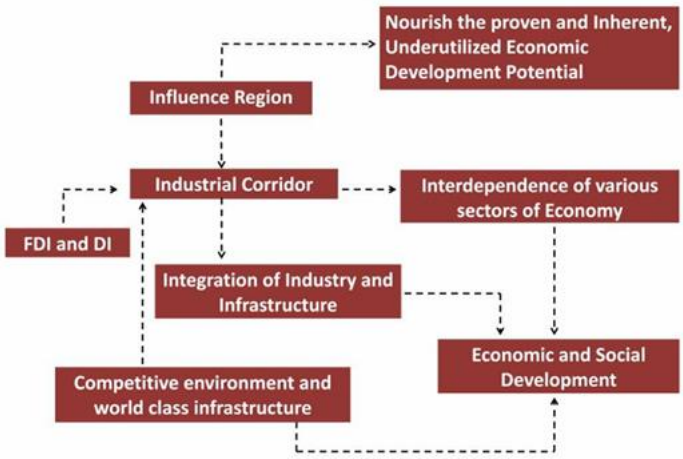

Nourish the proven and Inherent, Underutilized Economic Development Potential
Influence Region
Industrial Corridor
Interdependence of various sectors of Economy
FDI and DI
Integration of Industry and Infrastructure
Economic and Social Development
Competitive environment and world class infrastructure

Figure 2: Relationship of Industrial corridor and Economy

1.1.4 The Delhi-Mumbai Industrial Corridor

To tackle systemic challenges and promote a collaborative development model, the Government of India has launched the ambitious Delhi-Mumbai Industrial Corridor (DMIC) project. Spanning 1,483 km, this corridor connects the nation's political capital, Delhi, with its financial hub, Mumbai. This phased regional development approach seeks to drive economic growth, boost industrial activity, and transform the corridor into a global

manufacturing and trade hub.

Figure 3: The Delhi Mumbai Industrial Corridor

The Delhi-Mumbai Industrial Corridor (DMIC) is India's largest and most ambitious regional development project, designed to revolutionize infrastructure and economic growth. Stretching 1,483 km between Delhi and Mumbai, it links the country's political and commercial capitals. Covering an influence area of 436,486 sq km—around 14% of India's total landmass—the corridor aims to unlock immense economic potential. With financial and technical support from Japan, DMIC spans multiple states, including Uttar Pradesh, Haryana, Rajasthan, Madhya Pradesh, Gujarat, Maharashtra, Delhi NCR, and

union territories like Diu & Daman and Dadra & Nagar Haveli. It is expected to attract USD 90 billion in investments and create over 3 million direct jobs.

Government of India is developing the Delhi Mumbai Industrial Corridor (DMIC), first industrial corridor on the backbone of Western Dedicated Freight Corridor (DFC) between Delhi and Mumbai covering an overall length of 1504 km and passing through the states of Uttar Pradesh, Delhi NCR, Haryana, Rajasthan, Gujarat and Maharashtra, with end terminals at Dadri in the Delhi NCR and Jawaharlal Nehru Port (JNPT) near Mumbai. A band of 150 km to 200 km has been chosen on both the sides of the Freight corridor to be developed as the Delhi-Mumbai Industrial Corridor.

It has an influence area of approximately 436,486 sq km, about 14% of India's total geographic area. DMIC is notified as a mega infrastructure project being undertaken. It is expected to attract investments worth USD 90 billion and create direct employment opportunities for over 3 million people.

DMIC Impact Cities

S. No.	State Name	Zone	Impact Cities in the short to mid-term
1	Uttar Pradesh	North	Noida,Ghaziabad, Meerut and Dadri
2	Haryana	North	Faridabad, Palwal, Rewari, and Hissar
3	Rajasthan	North	Jaipur, Kushkhera-Bhiwadi-Neemrana
4	Gujrat	West	Vadodra, Ahemdabad, Baruch-Ankleswar-Dahej, Dholera and Surat
5	Madhya Pradesh	Central	Pitampura-Dhar-Mhow,Nimach-Nayagaon
6	Maharashtra	West	Nasik, Sinnar, Dhule-Nardhana and Pune

Table 1: Impact Cities

1.1.5 Regional Planning and Industrial Corridor Linkage

The Delhi-Mumbai Industrial Corridor (DMIC) aligns closely with several regional planning theories, particularly growth pole theory and new economic geography.

Growth Pole Theory: Concept: Proposed by François Perroux in the 1950s, the growth pole theory suggests that economic development is not uniform over a region but rather takes place around a specific pole (or cluster), which drives regional growth.

Application to DMIC: DMIC is designed to stimulate economic growth by creating industrial clusters or nodes along the corridor, which act as growth poles. These nodes are expected to have a spillover effect, fostering development in surrounding areas.

New Economic Geography: Concept: This theory, associated with Paul Krugman, focuses on the spatial distribution of economic activity, emphasizing the role of economies of scale, transportation costs, and agglomeration economies in shaping regional development.

Application to DMIC: The DMIC is an example of the clustering of industries and infrastructure to reduce transportation costs and benefit from economies of scale, leading to concentrated economic activity along the corridor.

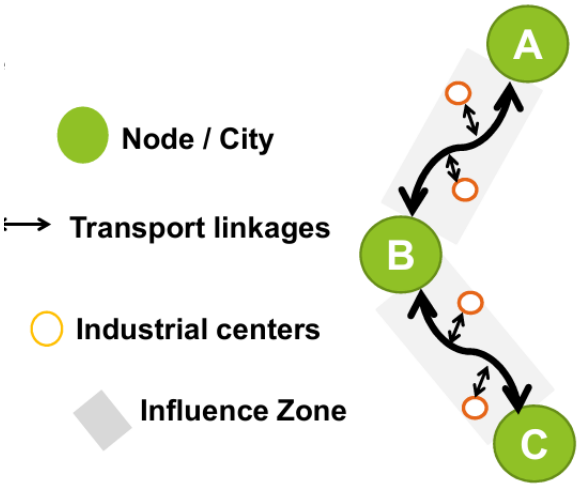


Figure 4: Trasport Nodes and Linkage

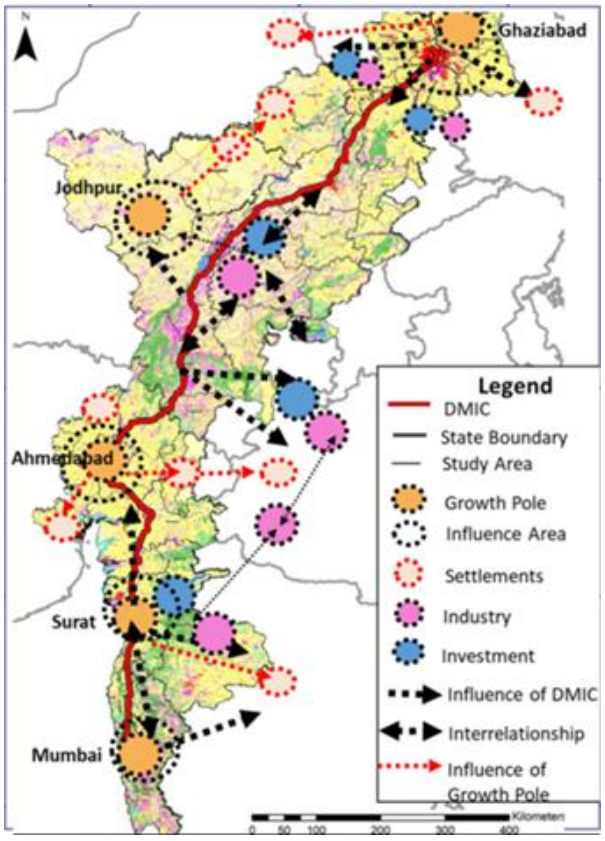


Figure 5: DMIC Growth Poles and Nodes

1.2 Need of the Study

The Delhi-Mumbai Industrial Corridor is poised to have a substantial impact on industrial growth and economy. It is designed to create industrial clusters, which can significantly boost industrial development. Studying this helps to understand the concentration and distribution of industries, their impact on the society, local economies, and potential challenges. The corridor enhances transportation and logistics infrastructure, which is vital for industrial development. Assessing its impact helps in understanding how vulnerable the areas are. The corridor also aims to diversify the economic base of the regions it passes through. Understanding this impact helps in planning and managing urban expansion effectively.

1.3 Aim

To prepare a framework for the planning of an area along the Delhi-Mumbai Industrial Corridor.

1.4 Objectives:

1. To study the concept of vulnerability Index and **evaluate vulnerability** within the 3 districts through **detailed surveys** and apply **Analytical Hierarchy Process (AHP)** for weighing indicators and further calculate the **vulnerability index** and further **identify the study area** based on the highest vulnerability index
2. To understand methods of **delineation of boundary** and use its parameters for **defining the boundary** of the study area.
3. To develop a **land potential/suitability map.**
4. To determine **activity** using **survey data** and **Space Syntax Network Analysis** and **identify gaps**.
5. To **recommend planning interventions** aimed at improving socio-economic equity, and infrastructure access

   .

1.5 Scope and Limitations

This corridor is first of its kind in India, hence there is a wide scope for exploration. Delhi-Mumbai Industrial Corridor (DMIC) is a significant example of large-scale infrastructure development in India. It aims to explore its role in driving economic growth, regional development, and industrialization.

The study will focus on areas along DMIC and the impact it has faced due to its development. The study will also assess planning, implementation, and outcomes, providing a framework for future development along the corridor.

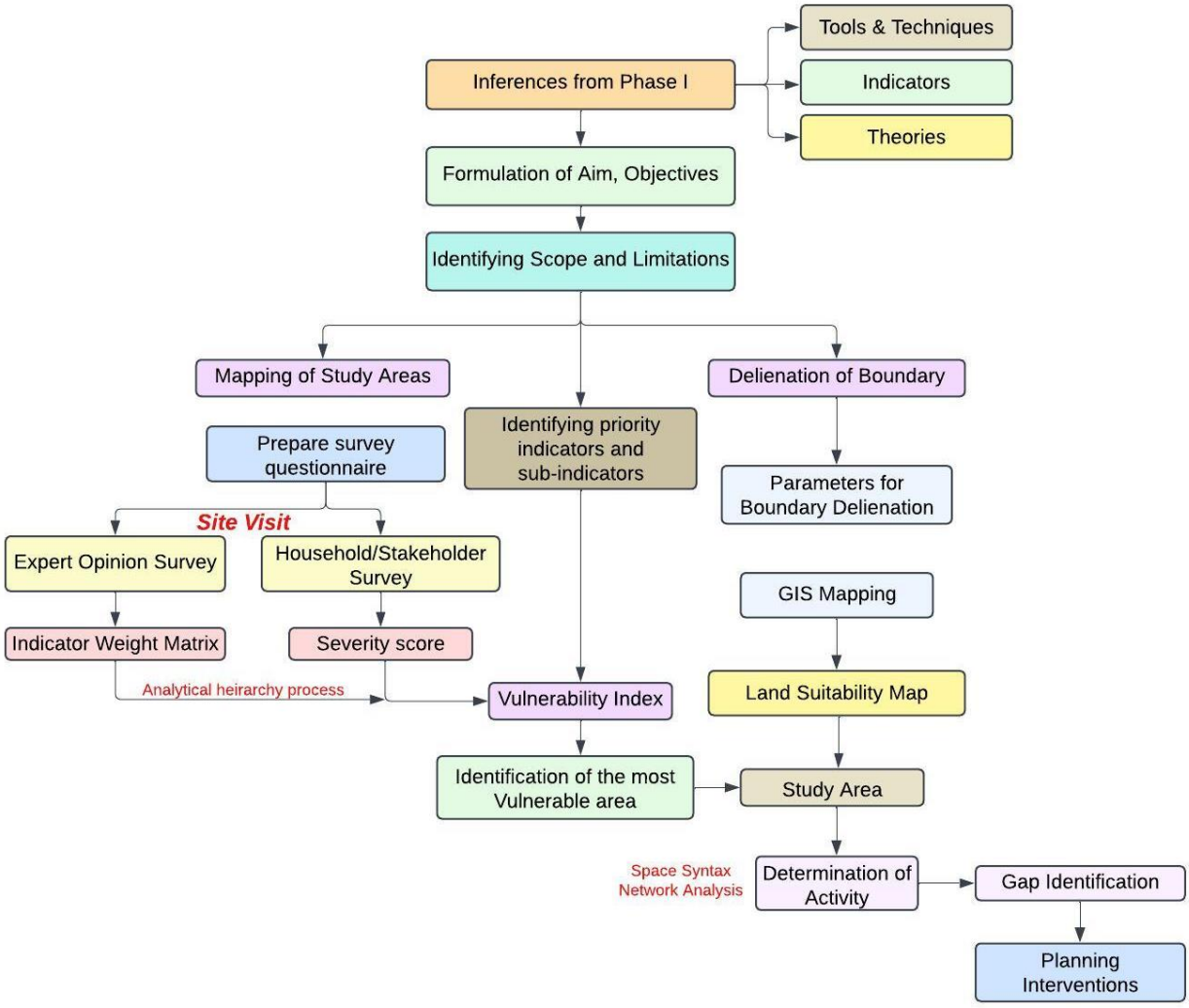
Given the 1500 km span of the DMIC, is too vast for detailed study in this thesis, thus this study will focus on a specific segment for in-depth analysis and targeted planning interventions.

Two districts were identified based on the maximum industrial growth. One district will be selected which will be most vulnerable for analysis for targeted interventions.

Land suitability is determined by two key factors: physical and environmental. However, to narrow the scope of this study, only the physical parameter will be considered for analysis.

The delineation of boundaries can be based on physical and geographical features, administrative divisions, economic clusters, urban, peri-urban, or rural areas, or through Environmental Impact Assessment (EIA). However, this study will adopt the economic cluster criterion, as it aligns with the industrial nature of the area. Focusing on economic clusters ensures that planning interventions are targeted and beneficial, given the critical role of economic activities in the region.

1.6 Methodology



Summary

The introduction lays the groundwork by explaining how transport infrastructure acts as both a stimulus and a reflection of industrial growth. It discusses how industrial corridors like the Delhi-Mumbai Industrial Corridor (DMIC) influence spatial, economic, and social dynamics. The study highlights the growing need for equitable and sustainable development in industrial zones like Bharuch, where industrial growth often outpaces human development. The chapter presents the aim: to create a planning framework that balances economic opportunity with infrastructure and quality of life improvements. It also outlines the research objectives, including the use of a vulnerability index, GIS, and Space Syntax to analyze spatial and socio-economic gaps. The chapter concludes by defining the scope and methodology of the thesis, emphasizing the need for a localized, people-centric planning approach in Bharuch's rapidly evolving landscape.

CHAPTER 02

VULNERABILITY INDEX FOR THE IDENTIFICATION OF STUDY AREA

This chapter outlines the methodology to assess and compare socio-economic vulnerability across districts using indicators like health, education, infrastructure, and demographics. It uses AHP and GIS tools to develop a vulnerability index, which helps identify Bharuch as the district most in need of spatial and social intervention.

2.1 Parameters and Indicators

The literature study and review of various research papers helped in finding out various indicators and parameters which is studied in this chapter. This would further help in the assessment of the Delhi Mumbai Industrial corridor for the select stretches.

2.1.1 Social Indicators

INDICATOR	DESCRIPTION	UNIT	METHOD/TOOLS
Population Growth and Migration	Tracks changes in population due to migration for job opportunities in the corridor.	Population growth rate (%)	Census data, population surveys, migration studies, and registration records.
Income Levels	Measures changes in per capita income, reflecting economic upliftment of the local community.	Currency (per capita income)	Household income surveys, income tax data, national accounts data.
Educational facilities	Tracks the availability of educational facilities	Number of facilities per population	Educational surveys, census data, government education records
Quality of Life	Assesses improvements in healthcare, housing, and amenities due to investments, indicating social progress	Index score (e.g., quality of life index)	Surveys on living standards, housing and health data, quality of life indices.
Healthcare Access	Tracks the availability of healthcare facilities	Number of facilities per population	Health facility surveys, census data, and healthcare system records.

Table 2: Social Indicators

2.1.2 Economic Indicators

INDICATOR	DESCRIPTION	UNIT	METHODS/TOOLS
GDP Growth Rate	Measures the increase in economic output generated by the corridor, showing overall economic development.	Percentage (%)	National accounts data, economic modeling, and analysis of regional GDP changes.
Employment Rate	Tracks the number of jobs created directly and indirectly, reflecting economic opportunities for the local population	Percentage (%)	Labor force surveys, employment data from industrial establishments, census data.
Industrial Output	Assesses the total value of goods produced within the corridor, indicating industrial activity and productivity.	Currency (USD or local currency	Labor force surveys, employment data from industrial establishments, census data.
Foreign Direct Investment (FDI)	Amount of foreign capital invested in the corridor, showing the attractiveness for international businesses.	Currency (USD or local currency)	Labor force surveys, employment data from industrial establishments, census data.
Export Growth	Measures the increase in exports facilitated by improved infrastructure, reflecting global market integration.	Percentage (%)	Trade data analysis from customs, export documentation, and industry reports.
Labor Productivity	Output per worker, indicating the efficiency and skill level within corridor industries.	Output per hour worked (currency/hour)	Calculation of GDP or industrial output per total labor hours, labor statistics, business productivity surveys.

Table 3: Economic Indicators

2.2Socio-Economic Vulnerability Index

Socio-economic vulnerability refers to the susceptibility of individuals, households, or communities to harm due to their social and economic conditions. Key factors contributing to socio-economic vulnerability include:

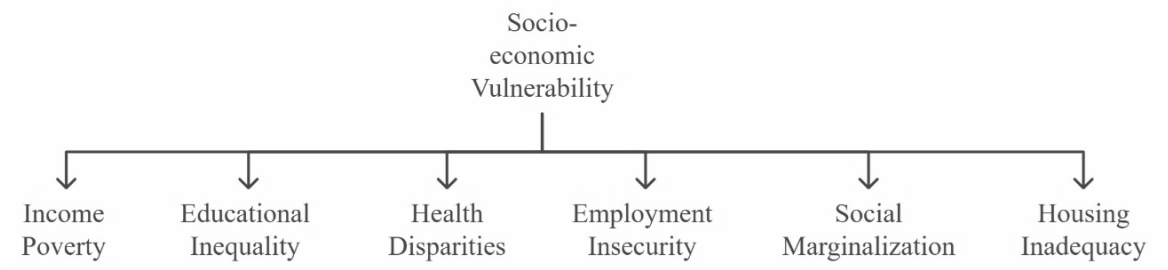


Figure 6: Socio Economic Vulnerability Parameters

A Socio-Economic Vulnerability Index (SEVI) is a composite measure that quantifies the degree of vulnerability in a population or region by combining multiple socio-economic indicators into a single score. It helps policymakers identify vulnerable groups or areas and design targeted interventions.

2.2.1 Socio-Economic Vulnerability Index Methodology

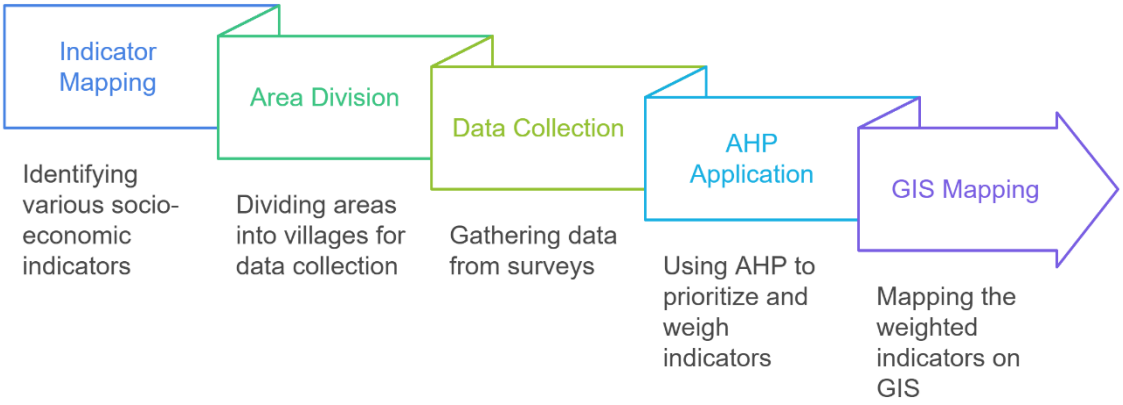


Figure 7: Socio Economic Vulnerability Assessment Process

The study involves multiple key steps, beginning with identifying and assigning appropriate weights to socio-economic indicators and their sub-categories. It then progresses to the creation of spatial information layers, which serve as the foundation for further analysis. Finally, Geographic Information System (GIS) is used to integrate this information effectively. GIS emerges as an invaluable tool for conducting spatial and analytical modelling, helping to meet the research objectives efficiently. Specifically, the study utilizes the Analytic Hierarchy Process (AHP**)** method to assign weights and analyse relationships, ultimately producing vulnerability maps that provide meaningful insights for decision-making. (Fatemi, 2023)

2.2.2 Socio-Economic Vulnerability Index Parameters

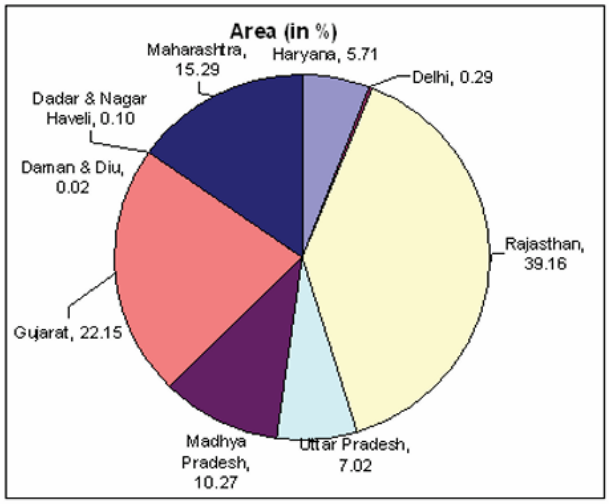
INDICATOR	SUB-INDICATOR	DESCRIPTION	UNIT	METHOD/TOOLS
Health Outcomes	Prevalence of diseases	Measures the incidence of health issues in the community.	Cases per 1,000 people	Health surveys, hospital records, census data
	Access to healthcare	Reflects availability of medical facilities and resources.	% population with access	GIS mapping of healthcare centers, household surveys
	Child mortality rate	Indicates child health and nutrition levels.	Deaths per 1,000 live births	Vital registration systems, DHS (Demographic and Health Surveys)
Education Access	Literacy rate	low literacy indicates education vulnerability	% literacy	Census data, local education department records
	School enrollment	Proportion of children enrolled in schools.	Enrollment %	School enrollment data, surveys
	Dropout rate	Reflects barriers to education continuity	% of students dropping out	Administrative data from education departments
Housing Conditions	Inadequate housing	Measures the share of people in overcrowded or unsafe housing.	% of population	Household surveys, census data
	Housing tenure	Indicates housing stability; renters are more vulnerable.	% of homeowners	Household surveys, property records
Employment	Unemployment rate	Tracks the proportion of people without work.	% unemployment	Labor force surveys, administrative employment data
	Informal employment	Reflects employment insecurity and lack of social protection	% in informal jobs	Labor surveys, government labor force reports
Income Levels	Poverty rate	Indicates economic vulnerability and deprivation	% below poverty line	Household income surveys, government poverty reports
	Per capita income	Tracks standard of living and economic well-being	Average income in Rs	Census data, income surveys
Demographics	Dependency ratio	Indicates economic strain on working-age population.	Ratio of dependents to workforce	Census data, labor force surveys
	Aging population	Reflects the proportion of elderly who may need additional support.	% population above 60	Census data
	Migrant population	Tracks mobility and integration challenges for migrant workers or displaced groups	% of population	Migration surveys, census data

INDICATOR	SUB-INDICATOR	DESCRIPTION	UNIT	METHOD/TOOLS
Access to Basic Services	Safe drinking water access	Indicates availability of potable water.	% population with safe water	Household surveys, government water utility data
	Sanitation facilities	Measures access to proper sanitation.	% population with toilets	Household surveys, administrative data
	Electricity access	Tracks availability and reliability of energy	% population with electricity	Household surveys, utility company records
Crime and Safety	Crime rate	Tracks overall safety and social stability.	Crimes per 1,000 people	Police records, community safety surveys
	Domestic violence incidence	Highlights vulnerabilities related to safety within homes.	% households affected	Social surveys, police or health service records
	Gender-based violence	Reflects safety issues specific to women	Cases per 1,000 women	Police records, women's organization reports
Environmental Vulnerability	Exposure to pollution	Reflects the level of exposure to environmental hazards.	Air Quality Index (AQI)	Environmental monitoring, satellite data
	Proximity to hazardous facilities	Tracks risks from industrial zones or chemical sites.	Distance in kilometers	GIS mapping
	Natural disaster exposure	Indicates vulnerability to floods, earthquakes, or other natural events.	% area prone to disasters	GIS mapping, historical disaster data
Cultural Vulnerability	Loss of traditional livelihoods	Reflects erosion of cultural resilience.	% shift away from traditional jobs	Government and NGO reports
	Heritage conservation	Tracks preservation of cultural landmarks	% heritage sites maintained	Health and nutrition surveys, administrative data

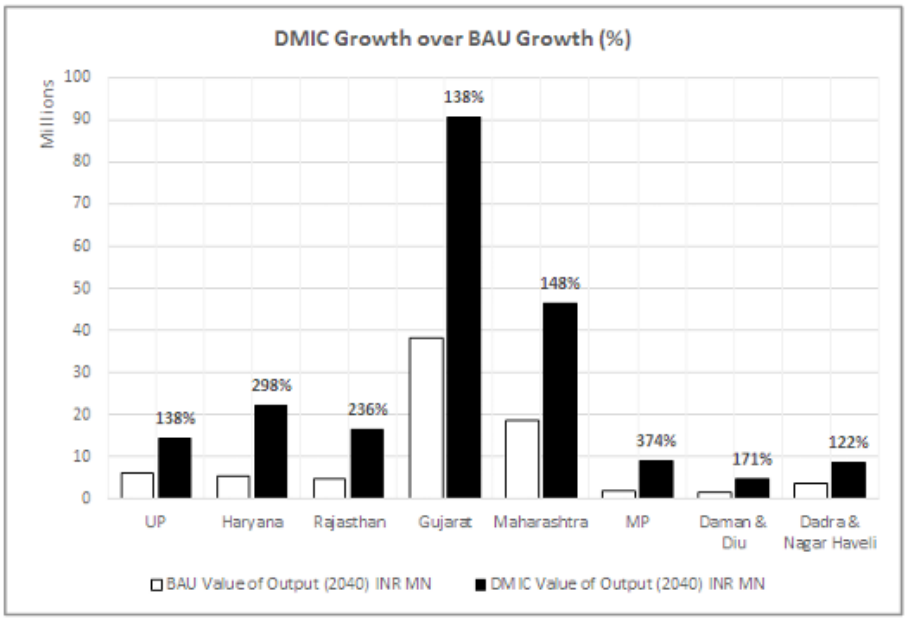
Table 4: Socio-Economic Vulnerability Indicators

2.3Selection of the potential state

The DMIC corridor links two of the country's largest urban agglomerations—Delhi, the political capital, with a population of 16.3 million (Census 2011), and Greater Mumbai, the financial capital, with a population of 18.4 million (Census 2011). At its core is the Dedicated Freight Corridor (DFC), which stretches from Dadri near Delhi to the Jawaharlal Nehru Port Trust near Navi Mumbai. This crucial infrastructure aims to reduce logistics costs, which are vital for the manufacturing industries expected to flourish along the corridor. (Meha Singla)



Graph 1: Percentage area covered by each state



Graph 2: State wise business as usual scenario

State	Gross Industrial Land Demand (in Sq Kms till 2040)	Gross Supply from IA & IR's (Sq Kms)	Demand Dynamics
UP	436	300	Significant demand differential ~ demand for industrial land spread across all districts.
Haryana	530	600	Significant demand for industrial land ~ however supply from IAs IRs sufficient
Rajasthan	776	700	Majority of demand differential spread across Udaipur and Chittorgarh
Gujarat	1,729	700	Majority of demand differential spread across Gandhinagar, Bhavnagar and Surat
Maharashtra	868	600	Majority of demand differential spread across Thane
MP	495	600	Significant demand for industrial land with sufficient supply from IA's and IR's
Daman & Diu	244	-	Significant demand for industrial land
D&N Haveli	125	-	Significant demand for industrial land

Table 5: Land Demand after DMIC *(Perspective Plan DMIC, 2009)*

Gujarat occupies a central position in the DMIC, offering seamless connectivity to major industrial hubs, ports, and global markets. Gujarat is known for its **pro-business policies**, with initiatives to attract industries through incentives, ease of doing business, and well-developed industrial estates. The state hosts **SEZs (Special Economic Zones)** and industrial clusters tailored to sectors like manufacturing, petrochemicals, and textiles, aligning closely with the objectives of DMIC. Gujarat is a leader in industrial growth, contributing significantly to India's GDP. The state accounts for a major share of India's **chemical**, **petroleum**, and **pharmaceutical** industries, supported by robust infrastructure and investor-friendly regulations. (Anil kumar Roy, 2023)

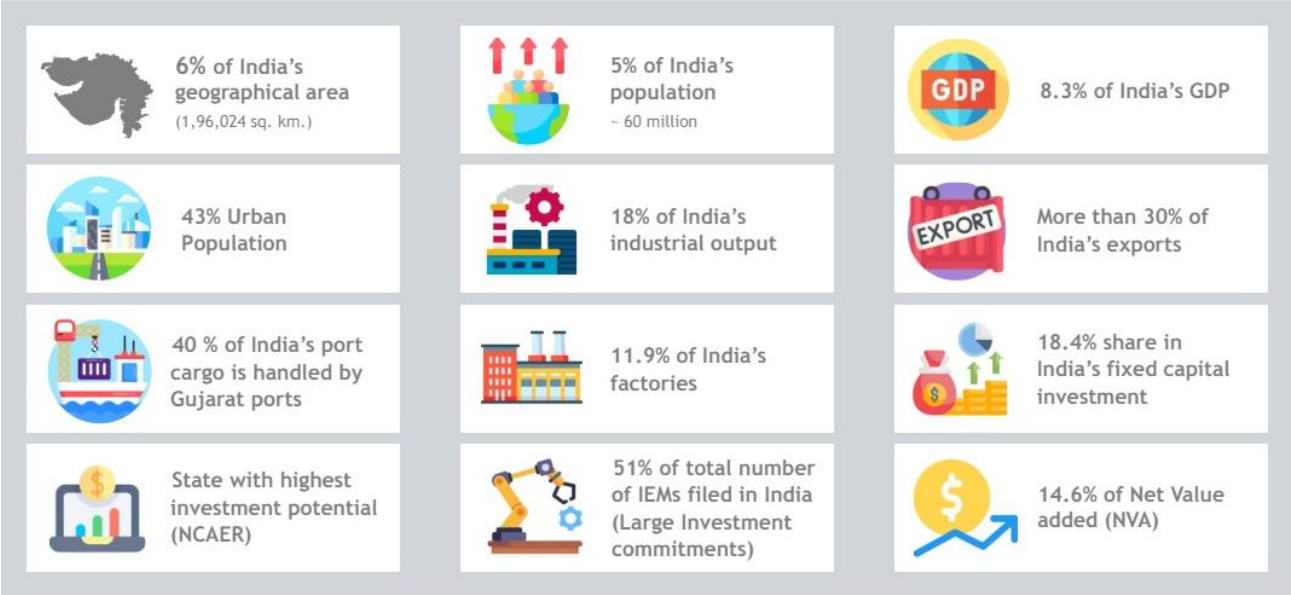

6% of India's geographical area (1,96,024 sq. km.)
5% of India's population ~ 60 million
GDP
8.3% of India's GDP
43% Urban Population
18% of India's industrial output
EXPORT
More than 30% of India's exports
40 % of India's port cargo is handled by Gujarat ports
11.9% of India's factories
18.4% share in India's fixed capital investment
State with highest investment potential (NCAER)
51% of total number of IEMs filed in India (Large Investment commitments)
14.6% of Net Value added (NVA)

Figure 8: Benefits in Gujarat

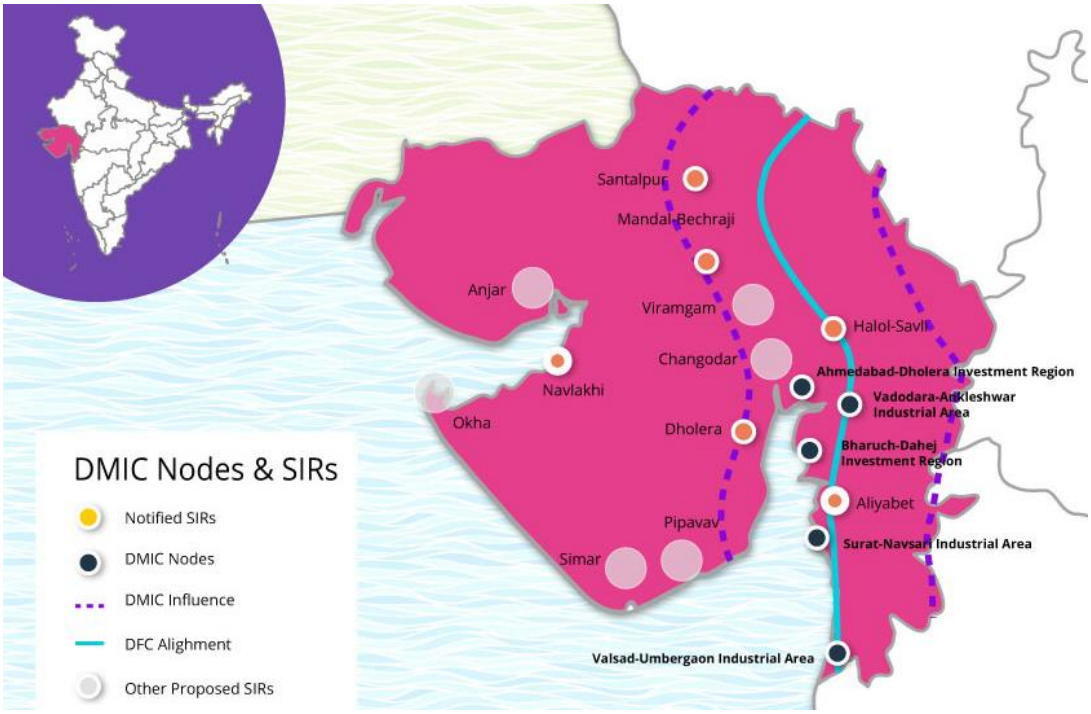


Figure 9: DMIC nodes and SIR's in Gujarat

2.4 Stretch Identification

Figure 10: Identified Districts

2.5 Site Survey

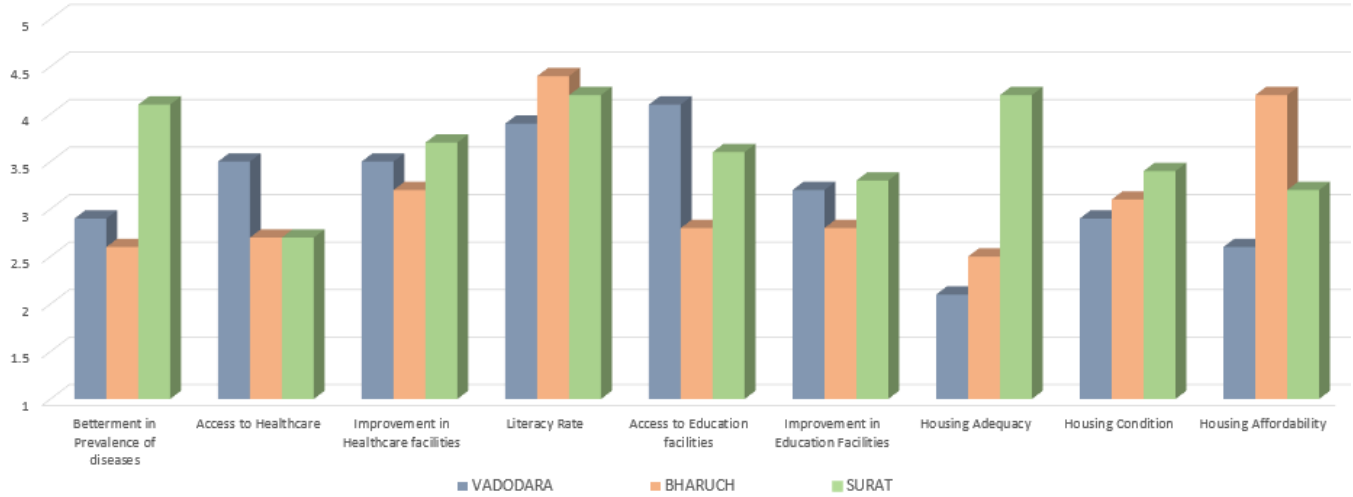
A site survey was conducted across three districts—Vadodara, Bharuch, and Surat—where a total of 100 samples were collected. The purpose of this survey was to analyse and determine which district is the most vulnerable based on key indicators, including social, economic, infrastructure, and demographic factors. To facilitate this analysis, a five-point Likert scale was developed, incorporating these indicators to systematically rank the districts. By assigning weighted scores to each parameter, a comparative evaluation was conducted to derive meaningful inferences. This assessment played a crucial role in finalizing the study area by identifying the district that exhibits the highest vulnerability. The survey questionnaire used for data collection is provided in **Annexure 1** for reference.

INDICATORS	SUB-INDICATORS	1	2	3	4	5
SOCIAL	Prevalence of diseases	Increased Prevalence	Slightly Increased Prevalence	Neutral	Slightly Decreased Prevalence	Decreased Prevalence
	Access to Healthcare	Very Poor	Poor	Neutral	Good	Very Good
	Improvement in Healthcare facilities	Worsened Significantly	Worsened Slightly	Neutral	Improved Slightly	Improved Significantly
	Literacy Rate	Very Poor	Poor	Neutral	Good	Very Good
	Access to Education facilities	Very Poor	Poor	Neutral	Good	Very Good
	Improvement in Education Facilities	Worsened Significantly	Worsened Slightly	Neutral	Improved Slightly	Improved Significantly
	Housing Adequacy	Worsened Significantly	Worsened Slightly	Neutral	Improved Slightly	Improved Significantly
	Housing Condition	Very Poor	Poor	Neutral	Good	Very Good
	Housing Affordability	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
ECONOMIC	Unemployment Rate	Worsened Significantly	Worsened Slightly	Neutral	Improved Slightly	Improved Significantly
	Poverty Rate	Worsened Significantly	Worsened Slightly	Neutral	Improved Slightly	Improved Significantly
	GDP per Capita	Worsened Significantly	Worsened Slightly	Neutral	Improved Slightly	Improved Significantly
	Business Opportunities	Worsened Significantly	Worsened Slightly	Neutral	Improved Slightly	Improved Significantly
	Economic Conditions	Worsened Significantly	Worsened Slightly	Neutral	Improved Slightly	Improved Significantly
INFRA STRUCTURE	Water Supply	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
	Sanitation Facilities	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
	Electricity Access	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
	Electricity Affordability	Very Cheap	Cheap	Affordable	Expensive	Very Expensive
DEMO-GRAPHICS	Inward Migrant Population	Decreased Significantly	Decreased Slightly	Neutral	Increased Slightly	Increased Significantly
	Homeless Population	Increased Significantly	Increased Slightly	Neutral	Decreased Slightly	Decreased Significantly
	Workforce	Decreased Significantly	Decreased Slightly	Neutral	Increased Slightly	Increased Significantly

Table 6: 5 pointer Linkert Scale

2.6 Survey Analysis

2.6.1 Social Factors



Graph 3: Social Factors

- **Disease Prevalence**: Surat has demonstrated notable improvement in managing the prevalence of diseases through better public health initiatives. In contrast, Bharuch continues to face higher incidences of illnesses, particularly Acute Respiratory Infections (ARI), which are most concentrated in this district, indicating environmental and healthcare challenges.

- **Healthcare Facilities**: Vadodara outperforms Bharuch in terms of healthcare access and infrastructure. It has better-equipped medical facilities, greater availability of health services, and more consistent improvement in healthcare delivery, while Bharuch lacks sufficient medical infrastructure and access to quality care.

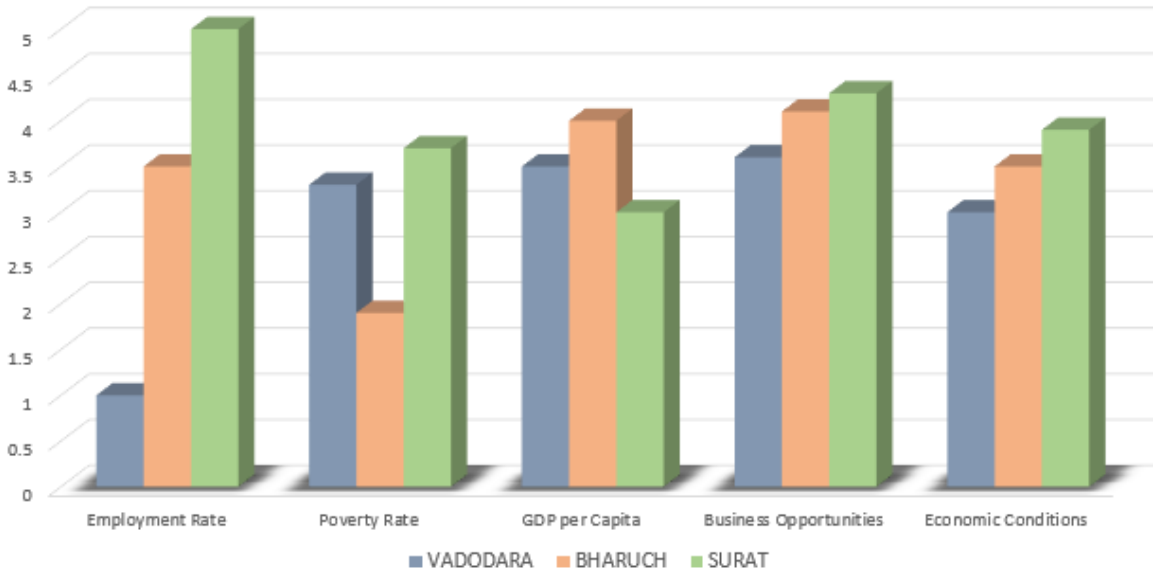
- **Literacy and Education**: Bharuch records a significantly higher literacy rate than Surat and Vadodara. However, the district lags behind in the provision of quality educational facilities. This reflects a disparity where basic literacy is present, but access to higher education or skilled learning environments is inadequate.

- **Housing Infrastructure**: Surat offers the most developed housing facilities among the three districts. The city's rapid urban growth is matched with extensive housing

development and improved living conditions, making it suitable for its expanding population.

- **Affordability in Bharuch**: Bharuch emerges as the most affordable district in terms of housing prices. However, the quality of housing is average, indicating that while cost-effective options are available, they often compromise on quality and amenities.

2.6.2 Economic Factors



Graph 4: Economic Factors

- **Unemployment Trends:** Surat district boasts an almost negligible unemployment rate, largely attributed to its booming industrial sectors, particularly textiles and diamonds. These industries have created a substantial number of job opportunities, significantly boosting employment levels. In contrast, Vadodara reports the highest number of unemployed individuals in Gujarat, with 26,507 people currently without jobs. This highlights the district's struggle to generate adequate employment despite being an important urban center.

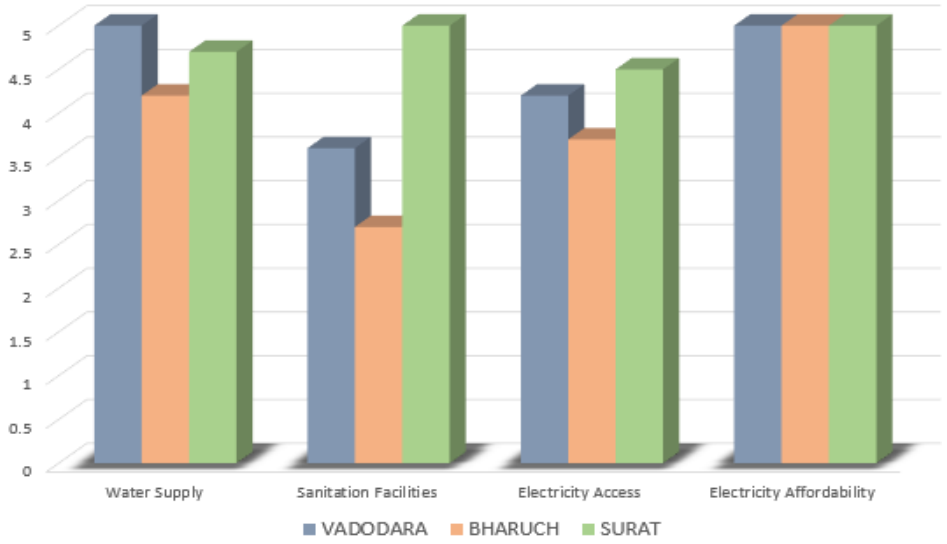
- **Poverty Levels:** Bharuch has the highest poverty rate among the three districts, standing at 12.28%. This is nearly double the poverty rates of Vadodara and Surat, which are recorded at 6.53% and 5.29% respectively. The high poverty rate in

Bharuch indicates economic disparities and challenges in ensuring inclusive growth.

- **Economic Performance (GDP):** Interestingly, Bharuch records a higher Gross Domestic Product (GDP) compared to both Vadodara and Surat, suggesting a strong industrial base and economic potential. However, this economic strength does not appear to significantly reduce poverty in the district.

- **Business and Household Economy:** Surat leads in terms of business opportunities and overall household economic conditions. The thriving industrial and commercial environment contributes to better living standards and economic stability. Vadodara, on the other hand, lags behind in both business activity and household economic well-being, pointing toward the need for economic diversification and investment.

2.6.3 Infrastructure Factors



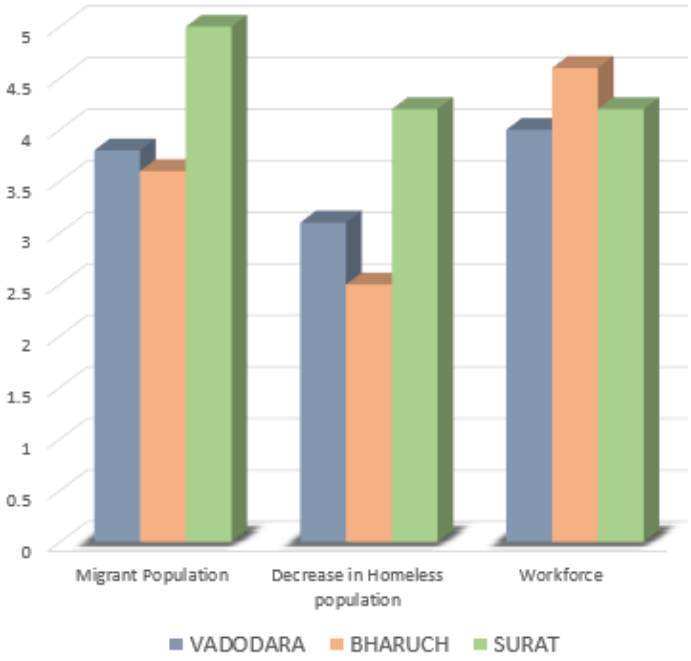
Graph 5: Infrastructure Factors

- Vadodara has become the sixth district in Gujarat to achieve 100% household tap water coverage under the Jal Jeevan Mission, ensuring safe drinking water for all. In Bharuch, 86% of villages are covered under the Har Ghar Jal Mission, reflecting steady progress in rural water access. In Surat, 95.7% of residents reported satisfaction with drinking water services, while only 4.3% expressed

dissatisfaction.

- Regarding sanitation, Vadodara has underground sewage coverage in 55% of its area, benefiting around 65% of its population. In Bharuch, rural sanitation has been significantly enhanced through NGO-led efforts, improving conditions in 66 villages and positively impacting over 20,000 people.
- Electricity supply across Vadodara, Bharuch, and Surat (excluding Surat city) is managed by MGVCL and DGVCL, while Surat city is served by Torrent Power Limited. Uniform electricity rates—₹25/month (single-phase) and ₹65/month (three-phase)—ensure consistent affordability across districts.

2.6.4 Demographics



Graph 6: Demographics

- **Migrant Population:** Surat has around 41.76 lakh migrant laborers, comprising 58% of its population. Bharuch has a migrant population of 36%, while 38% of Vadodara's population are migrants.

- **Homeless Population:** Bharuch has the highest number of homeless people. Surat has the least number of homeless individuals relative to its population.

- **Employment:** Surat provides employment to over 7 lakh people.
- **Workforce Participation Rate:**

Vadodara: 40.7%

Bharuch: 45.77%

Surat: 42%

2.6.5 Inference:

The overall analysis highlights distinct socio-economic characteristics across Surat, Bharuch, and Vadodara districts. Surat emerges as the most balanced and progressive district, driven by its strong industrial base, low unemployment, high migrant workforce, superior housing, and sanitation infrastructure. Despite a high migrant influx, Surat maintains the lowest homelessness and high satisfaction with public services. Bharuch, while economically strong with the highest GDP and workforce participation, faces significant challenges in poverty, disease prevalence (especially ARI), and housing quality. It also records the highest homelessness rate, suggesting economic benefits are not equitably distributed. Vadodara, although performing well in healthcare access and tap water coverage, struggles with the highest unemployment and inadequate housing availability. Its workforce participation remains lower compared to Bharuch. While electricity is uniformly affordable across all three districts, disparities in employment, healthcare, and basic infrastructure highlight the need for more inclusive and region-specific planning approaches to ensure balanced development and quality of life.

2.7 Calculation of Vulnerability Index

The **Vulnerability Index (VI)** is a composite measure used to assess the relative socio-economic, infrastructural, and demographic vulnerability across regions. In this case, the index was calculated for **Vadodara**, **Bharuch**, and **Surat** using a structured methodology involving expert opinions and household surveys.

2.7.1 Matrix for determination of weights for all indicators

(Based on data collected from Expert opinion survey)

A pairwise comparison matrix was developed to determine the relative importance of four major vulnerability indicators:

Social Indicators **Economic Indicators**

Infrastructure Indicators **Demographic Indicators**

Expert opinion surveys were conducted to rank the relative importance of each indicator using Saaty's scale (1 = equal importance, 3 = moderate importance, 9 = extreme importance).

	SOCIAL	ECONOMY	INFRA STRUCTURE	DEMOGRAPHICS
SOCIAL	1	9	5	7
ECONOMIC	1/9	1	3	5
INFRASTRUCTURE	1/5	1/3	1	3
DEMOGRAPHICS	1/7	1/5	1/3	1

Table 7: Matrix for determination of weights for all indicators

2.7.2 Normalization of Matrix

Each element of the matrix was normalized by dividing it by the sum of its column. This allows for uniform scaling and comparison. Normalized Value = Each entry /Sum of its column

SOCIAL	1 + 1/9 + 1/5 + 1/7	1.45
ECONOMY	9 + 1 + 1/3 + 1/5	10.53
INFRASTRUCTURE	5 + 3 + 1 + 1/3	9.33
DEMOGRAPHICS	7 + 5 + 3 + 1	16

Table 8: Normalization of Matrix

2.7.3 Determination of Weights

The normalized matrix values are then averaged row-wise to obtain the final **weight (W)** of each indicator. These weights represent the **relative importance** of each indicator in determining vulnerability.

	NORMALISED SOCIAL	NORMALISED ECONOMY	NORMALISED INFRA STRUCTURE	NORMALISED DEMO GRAPHICS	AVE RAGE
SOCIAL	1 / 1.45	9 / 10.53	5/9.33	7/16	0.63
ECONOMIC	1/9 / 1.45	1 / 10.53	3/9.33	5/16	0.20
INFRASTRUCTURE	1/5 / 1.45	1/3 / 10.53	1/9.33	3/16	0.12
DEMOGRAPHICS	1/7 / 1.45	1/5 / 10.53	1/3 / 9.33	1/16	0.05

Table 9: Determination of Weights

2.7.4 Severity Score

Severity scores (S) were derived based on primary household surveys conducted across selected settlements in the study area. Each score (ranging from 0 to 1) reflects the intensity of vulnerability experienced by the population in each domain.

CRITERIA	SEVERITY SCORE
SOCIAL	0.7
ECONOMY	0.5
INFRASTRUCTURE	0.8
DEMOGRAPHICS	0.6

Table 10: Severity Score

2.7.5 Vulnerability Index

The final **Vulnerability Index (VI)** for each indicator was calculated using the formula:

VI=Weight x Severity Score

CRITERIA	VULNERABILITY INDEX	TOTAL VI
SOCIAL	0.63 x 0.7 = 0.441	0.667
ECONOMY	0.20 x 0.5 = 0.100	
INFRASTRUCTURE	0.12 x 0.8 = 0.096	
DEMOGRAPHICS	0.05 x 0.6 = 0.030	

Table 11: Vulnerability Index

2.7.6 District-wise Vulnerability Index:

- **Bharuch: 0.667**
- Vadodara: 0.481
- Surat: 0.353

The index revealed Bharuch as the most vulnerable district with a score of 0.667, significantly higher than Vadodara (0.481) and Surat (0.353). This elevated score in Bharuch is primarily due to high severity in infrastructure and social indicators, indicating inadequate access to essential services and facilities. Given its multidimensional vulnerabilities, Bharuch presents a critical need for targeted development interventions. Thus, it was chosen as the study area to explore how strategic planning and proposals could transform it into a growth center, addressing its weaknesses while leveraging its potential.

Summary

This chapter introduces a multi-criteria decision-making approach to assess vulnerability across three districts—Bharuch, Surat, and Vadodara—using 21 socio-economic and infrastructural indicators. Through the Analytical Hierarchy Process (AHP), the indicators were weighted and scored using data from expert opinions and household surveys. GIS-based mapping and spatial analysis enabled the generation of a Socio-Economic Vulnerability Index (SEVI). Bharuch emerged with the highest vulnerability score (0.667), indicating significant deficits in infrastructure, public health, housing, and economic equity, despite having one of the highest GDPs among the districts. The findings reveal a disconnect between economic performance and human development. While Surat showed strength in housing and employment, and Vadodara in healthcare, Bharuch lagged in key social parameters. This vulnerability profiling served as a critical decision-making tool for identifying the final study area. The chapter concludes that strategic planning in Bharuch must address both the spatial and human dimensions of vulnerability to enable equitable regional development.

CHAPTER 03
IDENTIFICATION OF STUDY AREA

This chapter defines the geographic and functional boundaries of the selected area in Bharuch using criteria such as connectivity, existing settlements, land cover, and proximity to infrastructure. It includes land suitability analysis to determine the most appropriate region for proposing development strategies within the DMIC influence zone.

3.1 Introduction to the Study Region

Bharuch (formerly commonly known as Broach) in India, is a district in the southern part of the Kathiawar peninsula on the west coast of state of Gujarat.

Bharuch is an ancient city and is the 2nd oldest city of India. It is developed on the holy riverbank of Narmada. Bharuch's economy is largely dependent on the industries in the town. The city is loaded with various industries like cotton, fertilizers, dairy products, dyes, textiles, and paints.

Geographical Location	72.45° to 73.15° East (Longitude) 21.30° to 22.00° North (Latitude)
Area	6,509 Sq. Km 3.32% of total area of Gujarat State
District Headquarter	Bharuch
Talukas	08
No. of Panchayat/Villages	543/653
Demographic	
Population	**Total:** 15.51 lakhs **Male:** 8.05 lakhs, Female: 7.45 lakhs
Population density per Sq. km	238
Sex Ratio (Per 1000)	925
Total Average Literacy rate	81.51%
Average Rainfall	800 mm
Seismic Zone	Zone III
Major River	Narmada

Table 12: About Bharuch

The main focus industry sectors are Chemicals, petrochemicals and Pharmaceuticals, Engineering, Ports and ship building and Textiles. It also has many reputed multinational companies like Welspun OPAL, Videocon, Reliance, BASF, ONGC, GAIL etc.
The district witnesses a large number of industrial estates and Special Economic Zones (SEZ). Leveraging the existing industrial base, Bharuch attracts a large number of business conglomerates, such as, Sanofi Aventis, Glenmark, Lupin, BASF, Bayer Crop Science.

3.2 Delineation of boundary

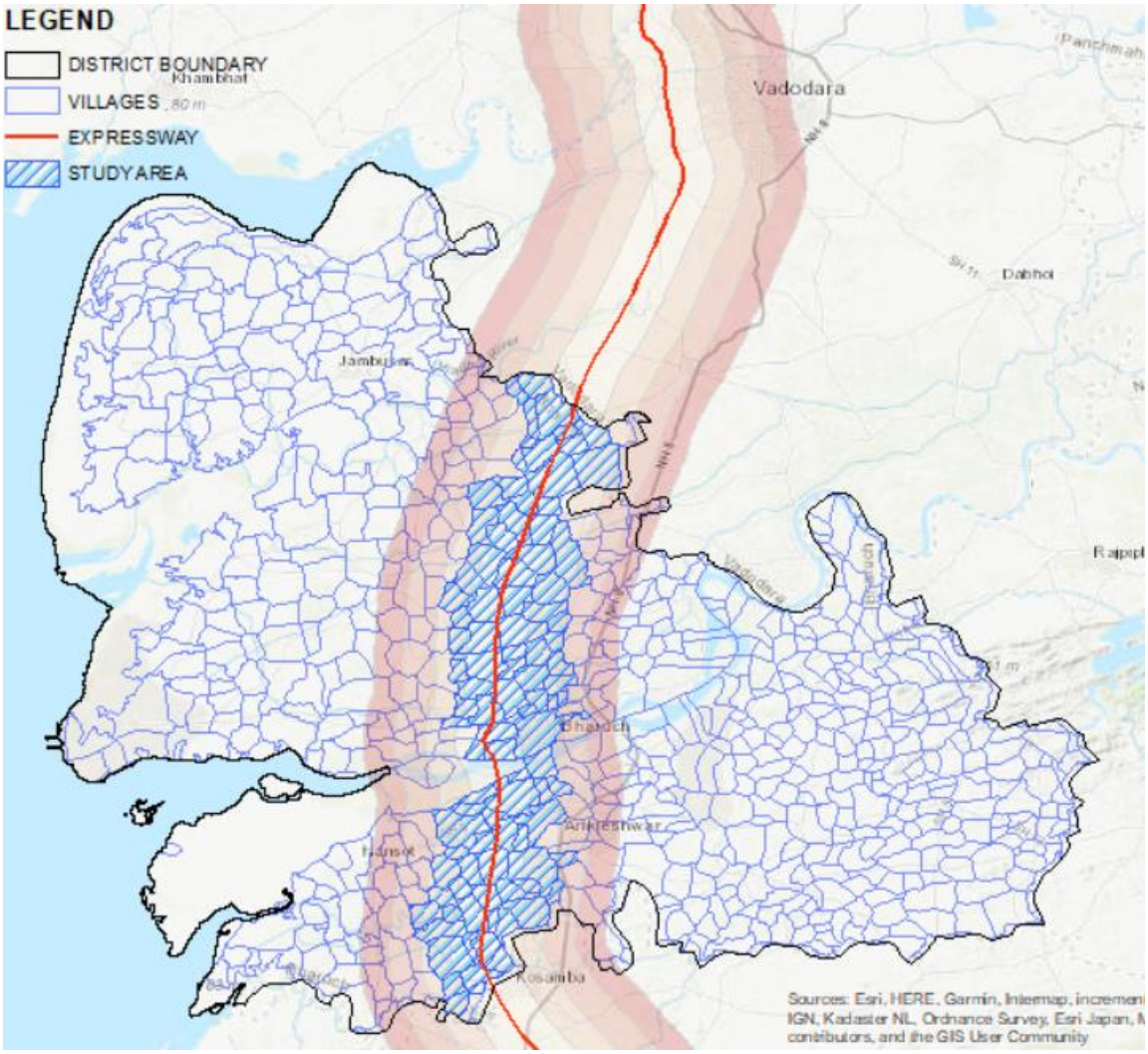
Delineation of boundary refers to the process of **defining and mapping the spatial limits** of a city, town, or designated development area. It helps in **organizing land use, managing growth, and ensuring efficient infrastructure planning**. The boundary delineation is based on various factors, including **geography, population distribution, administrative jurisdictions, and economic activities**.
Importance:

- Helps in **efficient land management** and **infrastructure development.**
- **Prevents** unplanned **urban sprawl** and ensures **balanced regional development.**
- Facilitates **better governance, taxation, and service delivery.**

3.2.1 Key Aspects of Boundary Delineation in Urban Planning

1. **Administrative Boundaries**: Defined by municipal, state, or national authorities for governance and policy implementation. It includes city limits, metropolitan regions, and planning zones.
2. **Functional and Land Use Boundaries**: Based on different land uses such as residential, commercial, industrial, and recreational zones. Ensures balanced urban growth and sustainable land use planning.
3. **Geographic and Environmental Boundaries**: Natural features like rivers, mountains, and forests often serve as boundaries. Consideration of flood-prone areas, seismic zones, and ecological conservation zones.
4. **Economic and Infrastructure Boundaries**: Defined based on industrial zones, transport corridors, and economic hubs. Ensures connectivity to highways, ports, and utilities like power and water supply.

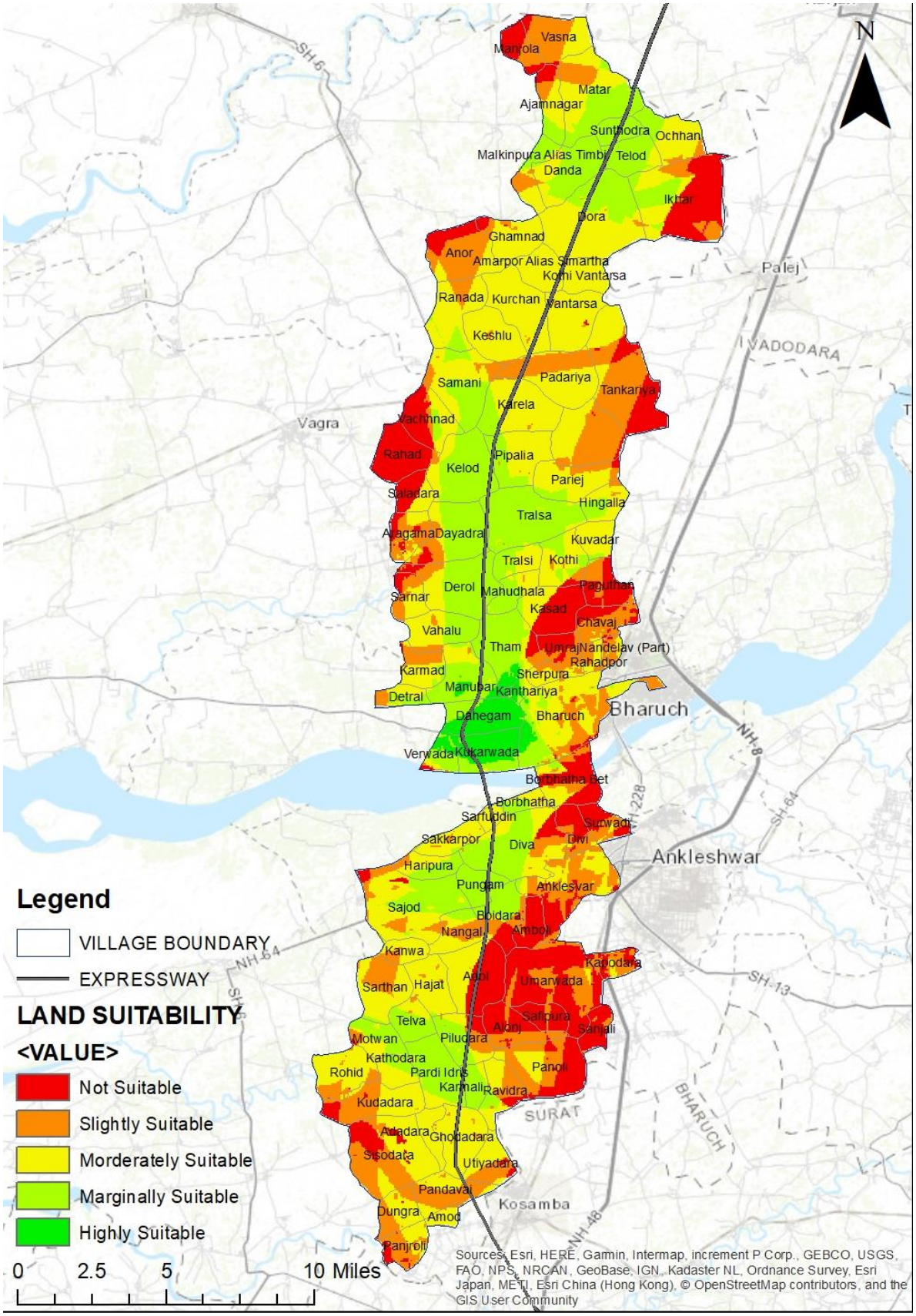
5. **Demographic and Social Considerations**: Population density, settlement patterns, and urban-rural transition areas influence boundary delineation. Provisions for housing, education, healthcare, and public services.
6. **Legal and Regulatory Framework**: Zoning laws, land acquisition policies, and master planning guidelines determine how boundaries are drawn.



Map 1: Area Delineation for Bharuch District

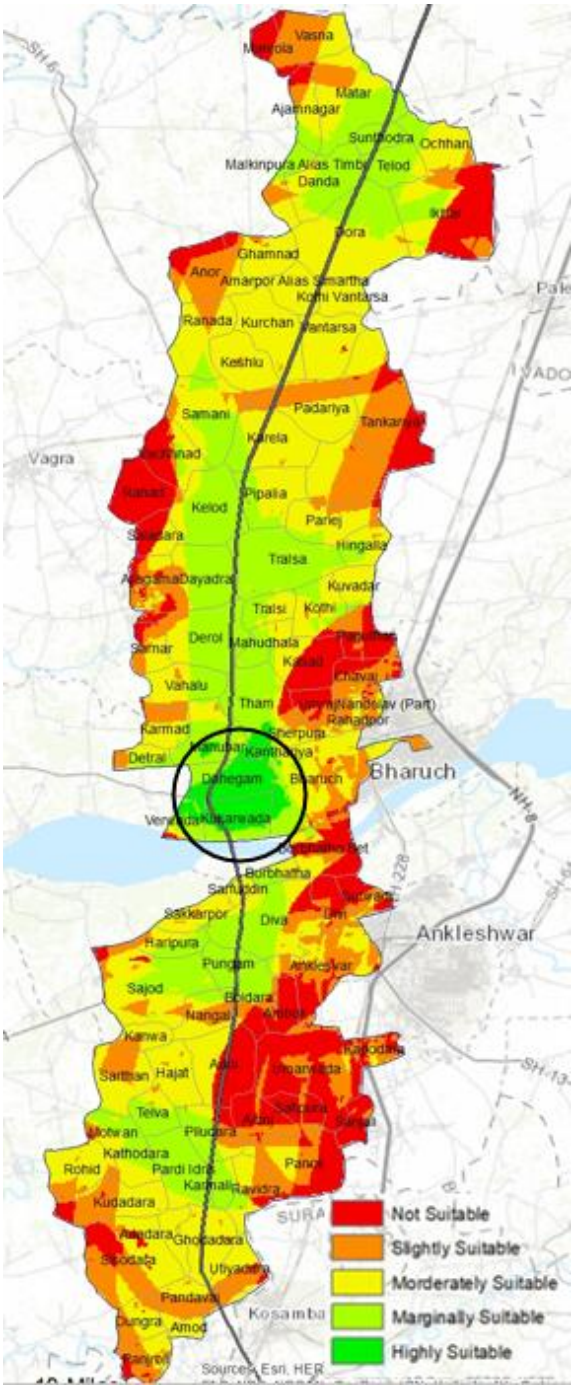
3.3 Land Suitability

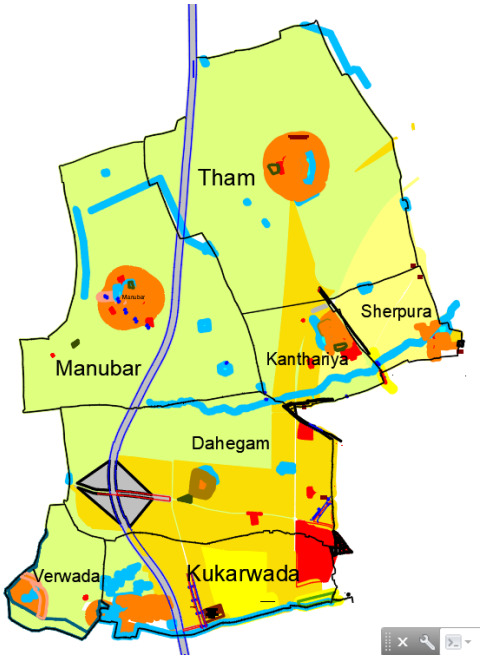
A land suitability map is a tool that identifies areas suitable for specific uses, like agriculture or development, by analyzing factors like soil type, slope, and climate. It essentially evaluates how well different areas of land can support a given purpose, based on their inherent characteristics. The output of this process is a map that visually represents the suitability of different areas for a specific purpose.



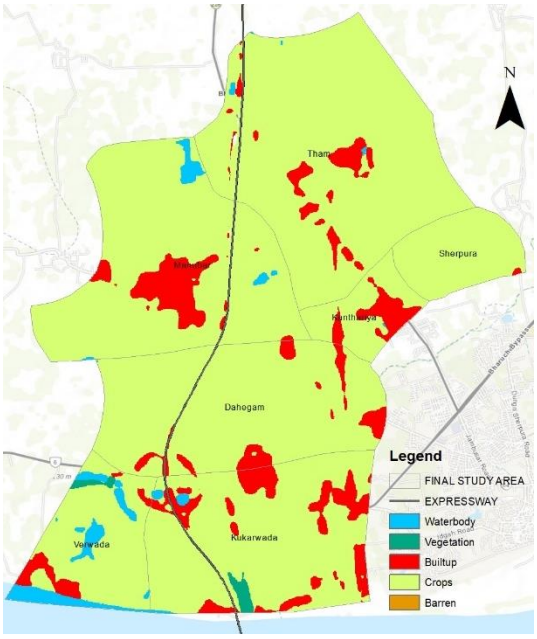
Map 2: Land Suitability

The land suitability map evaluates the Bharuch region using key **parameters such as proximity to expressways, highways, bullet train stations, water bodies, city centers, industrial hubs, workforce availability, population density, and land cover.** The analysis highlights that areas along the DMIC corridor—especially around **Bharuch and Ankleshwar—offer the highest suitability for future development.** Based on this comprehensive evaluation, a **final study area** has been chosen within the **'Highly Suitable' zone** for focused planning.





Map 3: Landuse map of the study area



Map 4: Landcover map of the study area

Summary

This chapter elaborates on the spatial and contextual factors that guided the selection of the final study area in Bharuch District. After identifying Bharuch as the most vulnerable district, a land suitability analysis was conducted using GIS, factoring in accessibility to roads, proximity to industrial hubs, and existing land use and cover. This analysis highlighted highly suitable zones near the DMIC and Ankleshwar industrial areas, which exhibit both development potential and accessibility advantages. The chapter further discusses administrative and functional boundaries for defining the focus area, aligning with planning principles to manage growth and infrastructure efficiently. The chosen area balances development opportunities with socio-economic need, capturing peri-urban villages like Kanthariya, Sherpura, and Dahegam. By grounding the study in both vulnerability and spatial potential, the chapter justifies the region as a critical intervention zone. It sets the stage for detailed spatial analysis and land use planning in the following chapters.

CHAPTER 04

ACTIVITY DETERMINATION

This chapter employs Space Syntax analysis to assess road network structure, connectivity, and spatial hierarchy. Combined with primary survey insights, it identifies functional gaps across villages. The aim is to understand how spatial layout influences activity distribution and where targeted improvements in land use and services are needed.

4.1 Activity Determination based on household survey

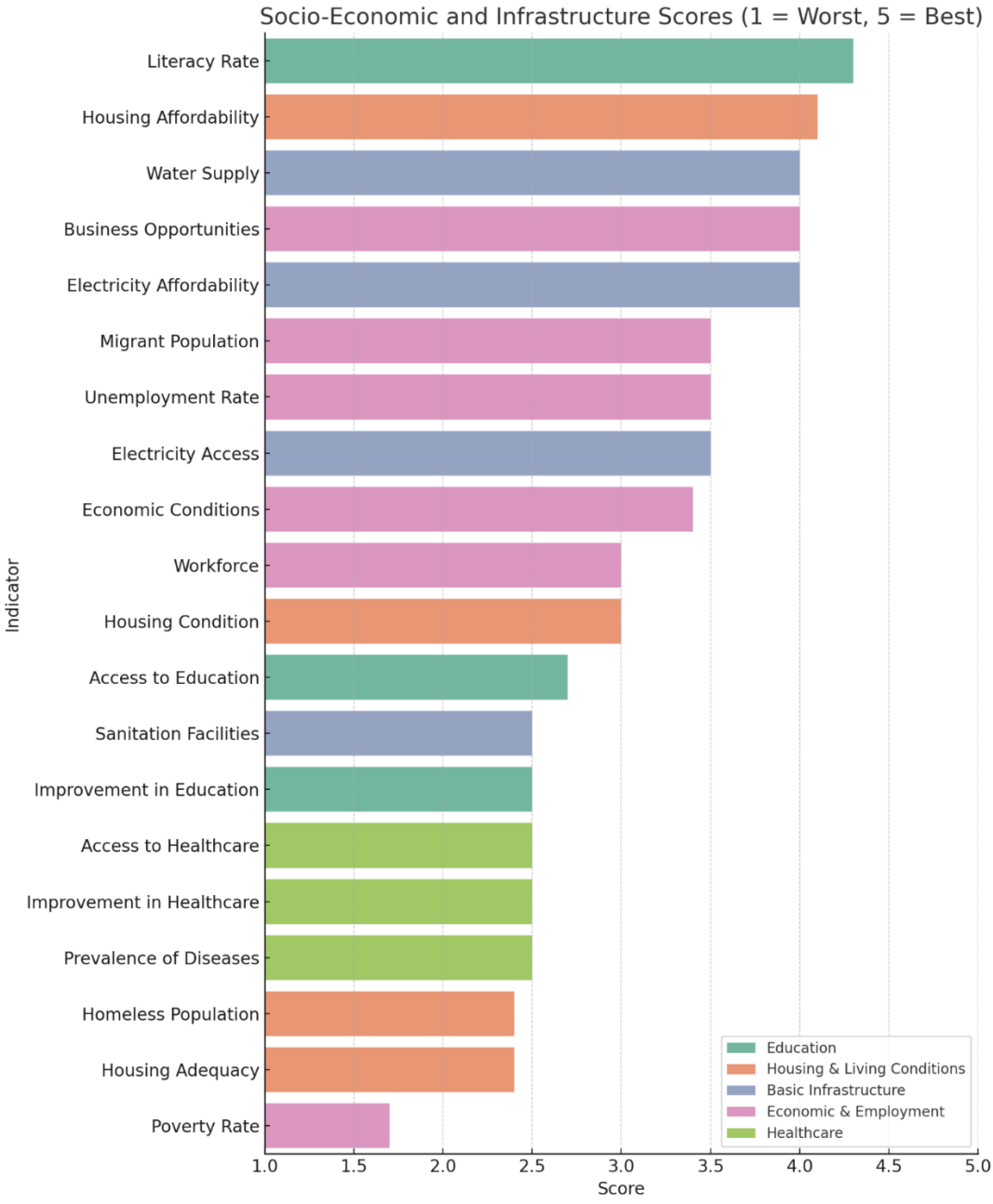


Figure 11: Activity Determination

The gap analysis of the study area reveals several critical disparities that undermine its potential for sustainable and inclusive development. **Socially**, the region demonstrates commendable literacy levels, indicating a population that values education. However, this achievement is not matched by access to quality healthcare and adequate housing, especially in remote villages. The absence of reliable healthcare services poses risks to public health, while poor housing infrastructure hampers living standards and social stability. There is a clear disconnect between educational attainment and the availability of essential social amenities needed to support that progress.

- **Economically**, while the area exhibits signs of emerging business opportunities and moderate employment generation, these have not translated into tangible poverty reduction. Livelihood opportunities remain limited in scope and are unevenly distributed across settlements, leading to socioeconomic imbalances and underemployment.
- **Infrastructure-wise**, although basic utilities like electricity and water are widely accessible, **sanitation facilities remain severely deficient**, especially in peripheral and rural pockets. Inadequate waste disposal and lack of sewage treatment contribute to environmental degradation and pose health risks.
- **Demographically**, the region sees a steady influx of migrants and has a youthful labor force, signaling potential for economic vitality. However, the presence of homelessness and lack of affordable housing options highlight the fragility of the support system for this population.

Overall, the region's **strategic location along the Delhi-Mumbai Industrial Corridor** is undercut by its low population density, underutilized land, and insufficient public services. Critical gaps in education, healthcare, housing, and sanitation must be addressed to fully leverage its development potential and ensure inclusive growth.

4.2 Space Syntax Network Analysis

Space syntax is a science-based, human-focused approach that investigates relationships between spatial layout and a range of social, economic and environmental phenomena.
It is a set of **spatial analysis techniques that examine the configuration of urban spaces and networks.** It helps quantify how spatial layouts affect movement, access, land use, and social behavior. The methodology is especially valuable in understanding **connectivity, accessibility, and potential movement patterns** within a built or planned environment. **For Delhi-Mumbai Industrial Corridor (DMIC)** in **Bharuch District**, Space Syntax helps analyze the **spatial structure and road network** of the region, particularly in terms of **connectivity between villages, the industrial corridor, and existing infrastructure.**

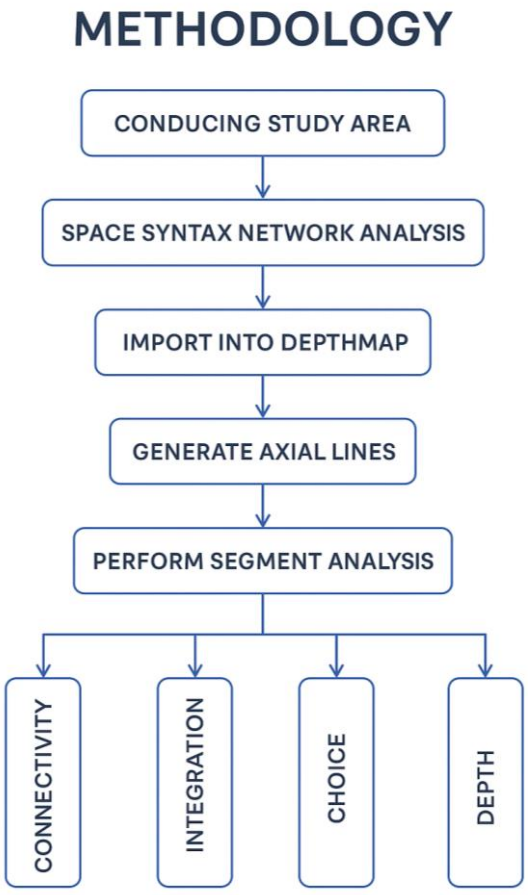
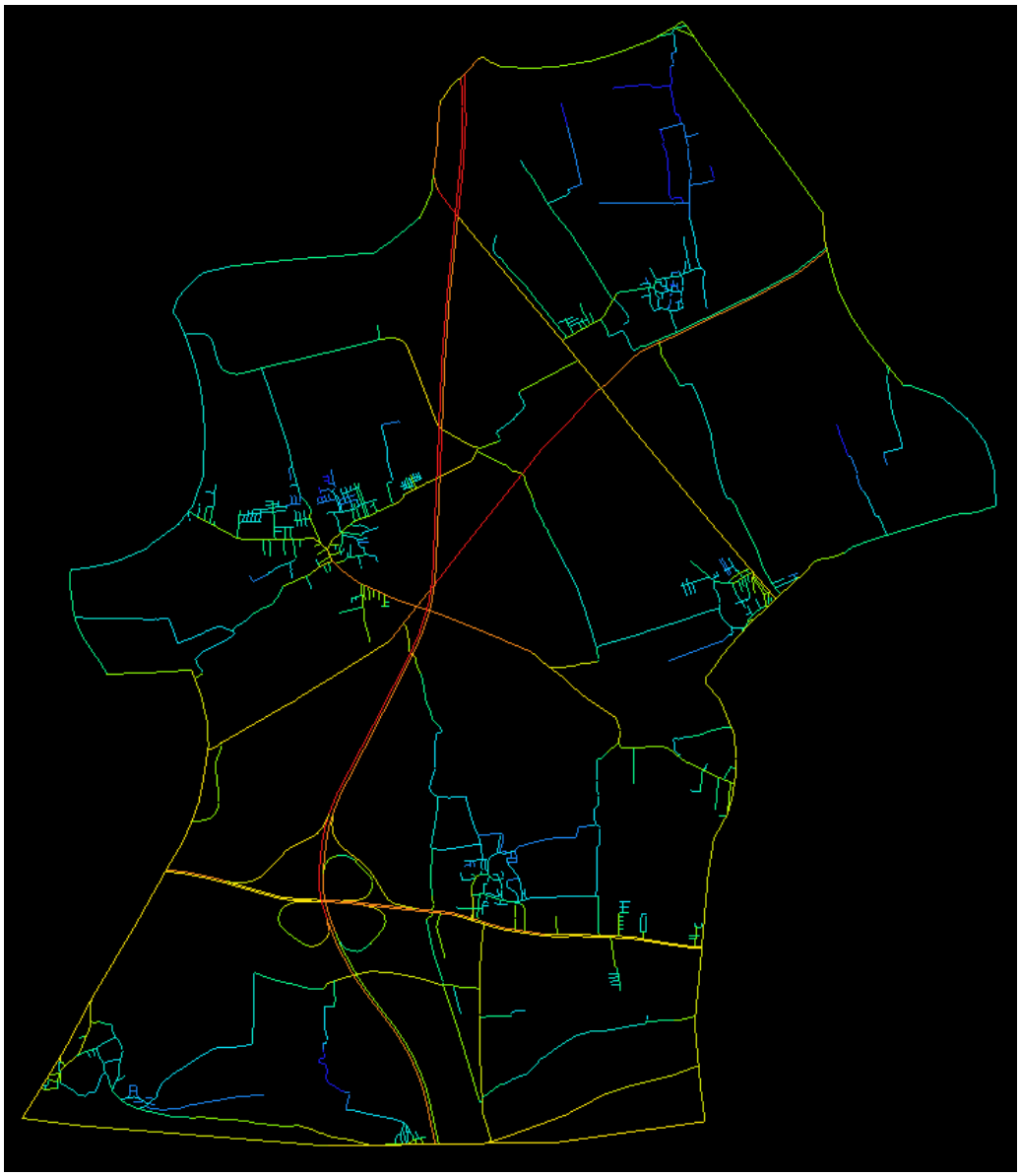


Figure 12: Methodology for Space Syntax Network Analysis

4.2.1 The integration map



Map 5: Integration Map

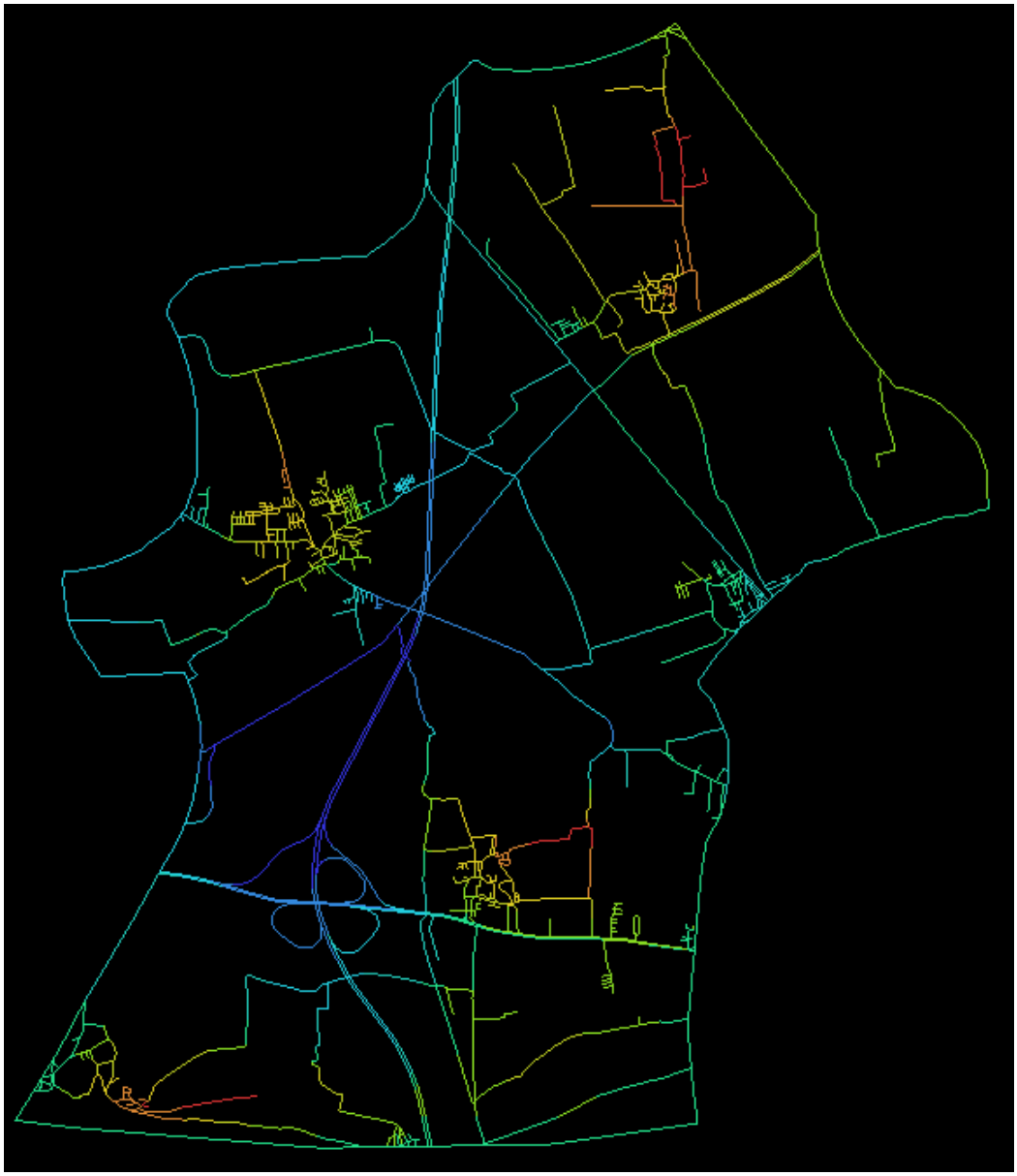
The segment-based integration map highlights a distinct spatial hierarchy within the study area. The Delhi-Mumbai Industrial Corridor (DMIC) emerges as the most integrated axis, facilitating major regional connectivity and movement. Surrounding this spine, settlements and residential clusters are concentrated along moderately integrated roads, suggesting their reliance on accessible transit routes. In contrast, peripheral areas with low integration levels likely correspond to agricultural, vacant, or less developed lands. This spatial differentiation reflects how integration values can predict land use patterns and guide future infrastructure planning, ensuring accessibility-driven growth, equitable development, and more informed zoning and land allocation strategies across the corridor.

4.2.2 The Choice axial analysis

Map 6: Choice Axial Map

The Choice axial analysis of the DMIC corridor region reveals a pronounced spatial hierarchy, with a central axial segment exhibiting the highest choice values. This segment functions as a key movement corridor, likely facilitating inter-village transit and regional flow. Diagonally aligned roads with moderate choice values enhance cross-settlement connectivity, enabling smoother interactions among villages. In contrast, roads with low choice values are generally internal or peripheral, corresponding to residential or agricultural land uses. This analysis highlights spatial potential for infrastructure upgrades, including the development of mixed-use corridors, improved public transit access, and pedestrian-friendly enhancements to support local and regional mobility.

4.2.3 The Entropy Axial Map



Map 7: Entropy Map

The Entropy Axial Map of the DMIC corridor area reveals critical insights into spatial complexity and predictability. High entropy values, prominently seen in village centers (marked in red), indicate complex and less predictable movement patterns with multiple route options. These areas are ideal for local commercial hubs, social interaction, and vibrant community activity due to their spatial richness. On the other hand, major roads and highway alignments display low entropy values (blue), representing structured, predictable pathways suited for efficient industrial flow, regional connectivity, and high-speed transit. This contrast aids in planning activity zones and appropriate land use interventions across the region.

4.2.4 The Segment Connectivity Map

Map 8: Segment Connectivity Map

The Segment Connectivity Map highlights the extent to which each road segment connects with its immediate surroundings, revealing the underlying spatial hierarchy of the study area. Roads with high connectivity (green) function as primary routes, facilitating movement between villages and acting as the backbone of local transportation. Moderately connected roads serve as secondary connectors, linking primary corridors with inner village roads. Low-connectivity roads (blue) typically access residential pockets or agricultural lands, supporting localized functions. This layered connectivity pattern assists in identifying strategic corridors for infrastructure development, improving access, and guiding land use planning aligned with movement intensity and functional hierarchy.

Village	Spatial Characteristics	Recommended Land Use / Policy Interventions
Manubar	**Moderate Integration** High Entropy (spatial predictability**)**	Initiate **village renewal scheme** Promote **heritage-sensitive development**
Dahegam	**High Integration** (red lines) **High Connectivity** **Low Entropy** Strong axial connections	Promoting **Transit-Oriented Development (TOD)** Allocate zones for **logistics/light industrial** use Strengthen **urban infrastructure** and last-mile connectivity
Kanthariya	**Moderate Integration** **High Entropy** (less structured)	Introduce **cluster-based rural service centers** Encourage **agro-based industries** and **skill centers**
Sherpura	**Low Integration** (less accessible) Low Connectivity Peripheral and isolated	Promote **community farming zones** Deploy **digital infrastructure** for inclusion
Tham	**High Integration** in local core Moderate Connectivity Lower Entropy (moderately organized)	Encourage **small-scale processing units** Establish **village hub for services**
Verwada	**Low to Moderate Integration** **Low Connectivity**	Provide **last-mile infrastructure** Promote **eco-tourism/agro-tourism** Introduce **renewable energy sites (solar farms)**
Kukarwada	**Moderate Integration** Moderate connectivity	Strengthen **nodal market center** Reserve land for **public utilities**

Table 13: Space Syntax Network Analysis Outcome

Summary

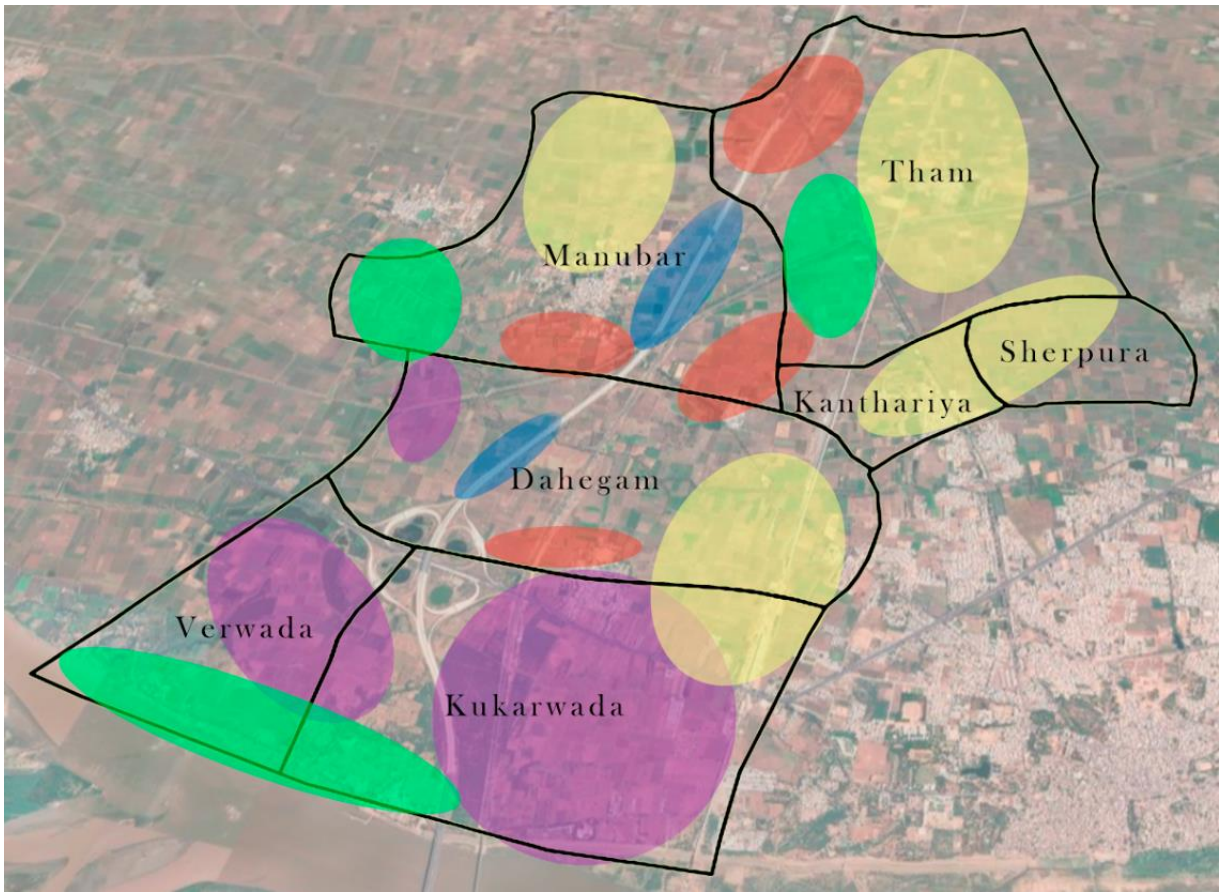
Space Syntax was applied to examine the study area's spatial configuration and movement patterns. Integration, choice, entropy, and connectivity maps revealed a strong axial spine along the DMIC, facilitating high connectivity and accessibility, especially in villages like Dahegam and Manubar. Villages such as Sherpura and Verwada, however, showed weak spatial integration and poor access to infrastructure. The entropy map identified village cores as vibrant yet disorganized, while highway corridors displayed structured movement. Primary household survey data supplemented these findings by identifying service delivery gaps in health, education, sanitation, and economic opportunities. Village-wise spatial profiles were developed, linking spatial conditions to suitable land use interventions—ranging from agro-industrial clustering in Kanthariya to eco-tourism in Verwada. The analysis helped spatially prioritize proposals for equitable development. The chapter concludes that spatial structure, when analyzed alongside social data, offers a powerful planning tool to determine where and how to implement development strategies within the DMIC context.

CHAPTER 05

DISCUSSION AND CONCLUSION

This chapter synthesizes findings and translates them into spatial proposals and policy-level recommendations. It introduces two land use plans—one based on expert opinion and another on URDPFI norms—focused on economic diversification, infrastructure equity, and sustainable growth in the DMIC-influenced study area.

5.1 Recommendations based on analysis



Map 9: Landuse proposal (URDPFI)

- **Residential** (20–25%)

Focused in Kanthariya**,** Sherpura**,** and Tham, particularly near existing village cores**.** Planned to cater to local housing needs, ensuring walkable access to amenities. Encourages compact, clustered residential development to preserve agricultural and natural land.

- **Commercial** (3–4%)

Strategically located along DMIC-adjacent high-access roads in Dahegam and Manubar**.**
Intended for retail, logistics outlets, and local trade facilities.
Supports economic activity without congesting residential areas, leveraging DMIC connectivity for business access.

- **Industrial (30–35%)**

Concentrated on the peripheral edges of Kukarwada**,** Verwada, and parts of Dahegam.
Focuses on logistics parks**,** light manufacturing units, and warehousing.
Avoids industrial encroachment into central areas, balancing employment generation with environmental concerns.

- **Public/Semi-Public (6–8%)**

Distributed across Kanthariya**,** Dahegam, and Sherpura to ensure spatial equity.
Allocated for schools**,** primary healthcare centres (PHCs)**,** vocational training institutes, and administrative buildings.
Aims to improve social infrastructure and support community well-being.

- **Recreational/Tourism (12–15%)**

Situated along the Verwada coastline, and on the edges of Tham and Manubar.
Includes eco-tourism zones**,** green buffers**,** community parks, and cultural recreation areas**.**
Promotes sustainable tourism, conserves natural assets, and enhances village-level economy.

5.1.1 Proposal Map 1 Inferences

- Industrial Saturation

Bharuch already hosts major industrial zones like Dahej and Ankleshwar, leading to high levels of industrial activity.
Further manufacturing expansion could strain natural resources, increase pollution, and cause urban congestion.

- Commercial-Led Growth Centre Vision

The study area is proposed as a commercial-led growth node, aligning with regional planning goals.

This shift is aimed at boosting local GDP and encouraging service-sector employment, offering a sustainable alternative to heavy industries.

- Survey Insights – Social Infrastructure Gaps

Community surveys highlight significant deficiencies in education and healthcare facilities. To address this, the development plan emphasizes a higher share of public/semi-public land use, accommodating schools, health centres, and community amenities.

- Economic Diversification Strategy

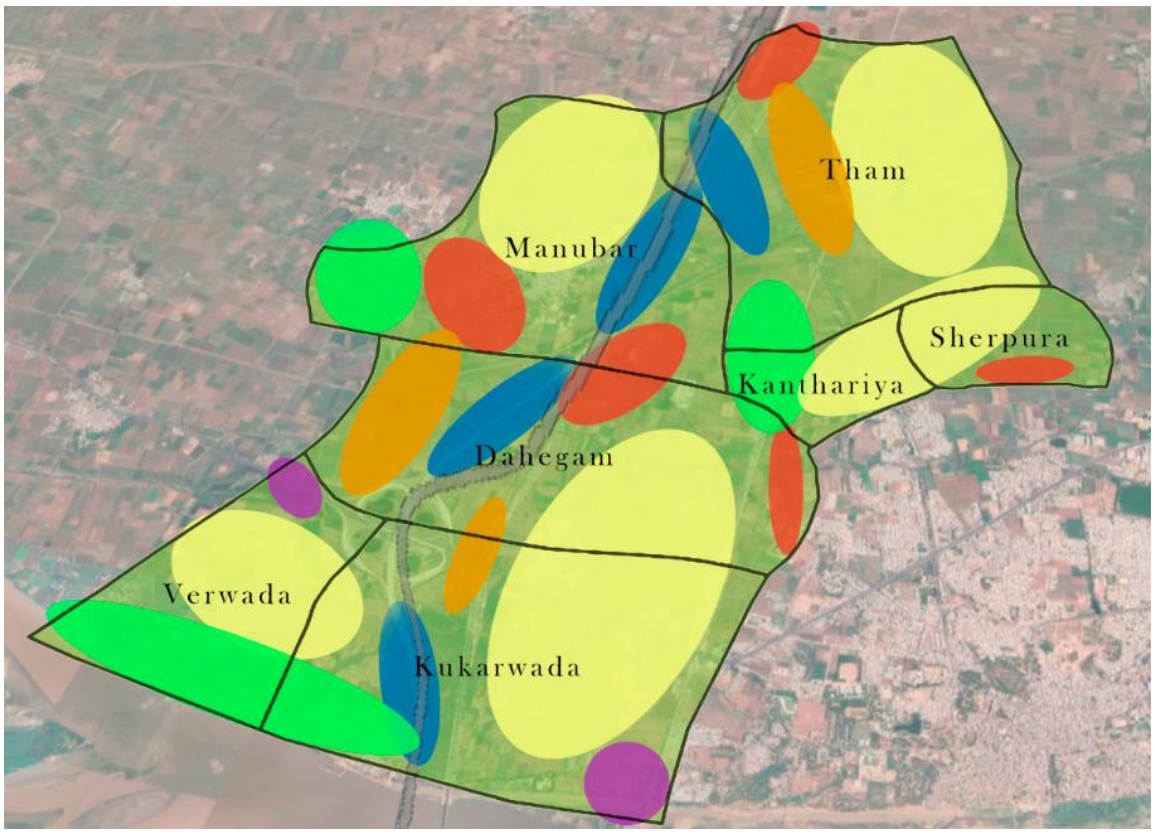
Reducing dependency on manufacturing by promoting sectors like retail, logistics, business support, and office-based services.

This fosters a more resilient and diversified economy, catering to a broader employment base, including youth and skilled professionals.

- DMIC-Driven Commercial Opportunities

The site's proximity to the DMIC offers excellent access to regional and national markets. This connectivity supports development of logistics hubs, office spaces, and retail clusters, harnessing the DMIC's spillover potential.

It positions the area as a strategic node for investment and commercial expansion, rather than traditional manufacturing.



Map 10: Landuse Proposal (Expert Opinion Survey)

- **Residential (40–45%)**

Allocated to accommodate local population growth and urban expansion.

Promotes affordable housing, mixed-income developments, and densification near key nodes.

Supports vertical growth and compact neighbourhoods, ensuring efficient land utilization.

- **Commercial (12–15%)**

Located along high-integration and high-choice corridors, as identified through network analysis.

Designed to attract retail, logistics, offices, and service-based enterprises.

Aims to enhance local GDP and create white-collar employment opportunities.

- **Industrial (3–5%)**

Strategically limited to low-density peripheral zones, such as the Kukarwada edge.

Avoids overburdening existing industrial belts in Bharuch (e.g., Ankleshwar, Dahej).

Supports light manufacturing, storage, and ancillary activities without harming livability.

- **Public/Semi-Public (12–15%)**

Based on survey findings, highlighting lack of access to education, health, and social infrastructure.

Located near village centres and major connecting roads for accessibility.

Includes schools, PHCs, community centres, and administrative hubs for equitable service delivery.

- **Recreational/Tourism (12–15%)**

Leveraged along Verwada's waterfront and low entropy areas for eco-tourism and cultural assets.

Designed to provide open spaces, green belts, and leisure facilities.

Targets employment generation for youth and women in hospitality and tourism sectors.

- **Mixed-Use (10–12%)**

Promotes vertical, walkable development by integrating residential, retail, and public services. Ideal for transit-oriented development and nodal zones with high accessibility.

Encourages urban vibrancy and reduces travel time between home, work, and amenities.

- **Agricultural (Area as per existing coverage)**

Preserved to support local livelihoods, recognizing agriculture as a primary occupation.

Ensures food security, maintains green cover, and acts as a natural buffer against sprawl.

Helps sustain the ecological balance and protects rural character of the region.

5.1.2 Proposal Map 2 Inferences

- **Commercial Hub around DMIC Corridor**

Concentrating commercial land use around the DMIC corridor leverages high connectivity and visibility.

Establishes a strong market centre to attract retail chains, logistics firms, and office-based enterprises.

Generates significant employment opportunities in non-industrial sectors.

Contributes to Bharuch's GDP growth by shifting the economic focus toward trade, services, and business support activities.

- **Equitable Distribution of Social Infrastructure**

Schools, skill development centres, and primary healthcare facilities are strategically located near residential clusters.

Ensures easy access for all socio-economic groups, especially youth, women, and marginalized communities.

Promotes social equity and improves human capital in the region by addressing key developmental gaps identified through surveys.

- **Mixed-Use Development for Urban Efficiency**

Encourages integration of residential, commercial, and institutional uses within the same zone.

Enhances walkability, reduces commuting distances, and supports transit-oriented development (TOD).

Promotes compact, vertical growth, leading to more efficient land use and reduced infrastructure burden.

- **Economic Repositioning of Bharuch**

Shifts the district's identity from being an industry-dominated area to a multi-sectoral economic node.

Emphasizes commercial, institutional, and service sectors as key growth drivers.

Supports economic diversification, making Bharuch more resilient to industrial market fluctuations and enhancing its regional significance.

5.2 Policy Level Interventions

- **In fill Development**: Use vacant or underutilized land within existing village cores.

Incentivize densification through land reconstitution, compact block planning, and incremental housing. It Improves the urban fabric and avoids sprawl while maximizing existing infrastructure.

- **Public Utility Spaces:** Integrated at ward/village level with land earmarked for essential services like anganwadis, PHCs, government schools, and community halls. Their placement ensures 5–10-minute walking access from major residential pockets.

- **Affordable and Rental Housing**: Develop affordable housing for migrants and low-income groups. Using PPP models and government schemes (e.g., PMAY). It will bring in working population attracted by nearby industries and commercial zones, reducing informal housing.

- **Transit Oriented Development**: Promote higher-density development around transit infrastructure (DMIC expressway, highway exits). Introducing mixed-use zoning and higher FSI (Floor Space Index) within 500–800m buffers of transit nodes like *Dahegam* and *Manubar*. It will encourage walkability, support public transport, and concentrate growth where infrastructure exists

- **Urban Densification:** Declare designated areas for higher population and construction density. Offering tax rebates and fee reductions for higher-density housing projects. It will Create vibrant urban clusters and support service economies near DMIC

5.3 Conclusion

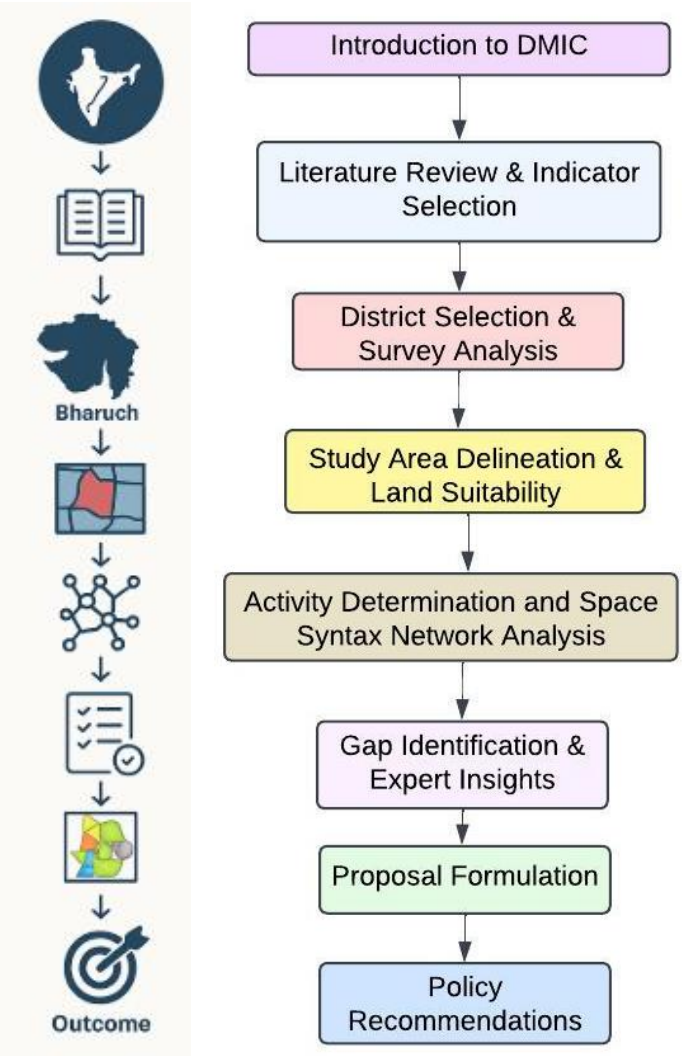


Figure 13: Framework

Through a multi-layered approach combining spatial analysis, household surveys, land suitability, and expert validation, this thesis has effectively tried to redefine the development trajectory of the study area. Strategic zoning has been employed to channel growth by allocating higher percentages of land to commercial, public/semi-public, and mixed-use categories. These zones were deliberately placed along high-accessibility routes identified through Space Syntax analysis to maximize connectivity, footfall, and economic vibrancy.

The reduction of industrial land despite the area's location within an industrial corridor was a conscious choice to prevent environmental saturation and to diversify the economic base. The integration of public infrastructure such as schools and healthcare facilities

addressed service delivery gaps observed in the field survey, thereby ensuring social equity alongside economic development.

By retaining agricultural land in peripheral zones, the proposal sustains traditional livelihoods while balancing ecological concerns. The mixed-use zones further support urbanization by encouraging compact, walkable, and multifunctional neighborhoods.
Overall, the thesis establishes the study area as a resilient, inclusive, and commercially dynamic growth centre capable of contributing to Bharuch's GDP not merely through industry, but through a balanced and future-ready urban framework.

Future scope of research

This thesis builds a strong base for planning development along the Delhi-Mumbai Industrial Corridor (DMIC) in Bharuch. However, there are many areas where future research can add more depth and detail. One important area is the use of **land use change models** to predict how the region may grow in the future as new infrastructure and industries come up. Researchers can also study **people's travel patterns** in more detail using tools like GPS tracking or mobile apps, which will help improve transport and road planning.

Another area for future study is **climate-friendly infrastructure**. Since the region includes both rural and industrial zones, it is important to plan for flood protection, waste management, and clean energy use. **Satellite images and digital tools** like GIS and AI can also be used to regularly monitor how land is being used and to support smarter decision-making.

Social aspects can also be explored more deeply. Studies focusing on **jobs, housing, and basic services** especially for migrant workers and low-income families—can help make development more inclusive.

In short, future research can make planning more accurate, inclusive, and better prepared for challenges like rapid urban growth and climate change.

ANNEXURE I

Household Survey

1. Name of Household Head:

_____

2. Address, Village:

_____

3. Total Number of Household Members:

_____

4. Occupation of Main Income Earner:

- ☐ Farmer
- ☐ Self-employed
- ☐ Government employee
- ☐ Private sector employee
- ☐ Unemployed
- ☐ Other: _____

5. Distance of Residence from Nearest Industrial Zone

    - ☐ <5 km
    - ☐ 5-10 km
    - ☐ >10 km

SOCIAL FACTORS

This survey is designed to understand the impact of development initiatives, such as the Delhi-Mumbai Industrial Corridor (DMIC), on social factors related to health, education, and housing conditions.

1. To what extent has the establishment of Industrial corridor improved healthcare facilities in your area?

	1	2	3	4	5	
Worsened Significantly	◯	◯	◯	◯	◯	Improved Significantly

2. Have you noticed any changes in the prevalence of diseases due to industrial development in your region?

	1	2	3	4	5	
Increased Prevalance	◯	◯	◯	◯	◯	Decreased Prevalence

3. Do you think the health infrastructure is adequate to support the growing population due to industrial development?

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

4. Have you experienced an increase in air or water pollution due to the development of corridors in your area?

	1	2	3	4	5	
Significant Increase	◯	◯	◯	◯	◯	No Increase

5. To what extent have educational facilities (schools, vocational centers) improved as a result of DMIC-related development?

	1	2	3	4	5	
Worsened Significantly	◯	◯	◯	◯	◯	Improved Significantly

6. Do you feel industrial development has created opportunities for better education?

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

7. Has the development of industrial zones improved housing conditions in your area?

1 2 3 4 5

Worsened Significantly ◯ ◯ ◯ ◯ ◯ Improved Significantly

8. Has housing affordability improved due to the DMIC-related development?

1 2 3 4 5

Worsened Significantly ◯ ◯ ◯ ◯ ◯ Improved Significantly

9. Do you believe the development of DMIC has improved the overall quality of life in your area?

1 2 3 4 5

Strongly Disagree ◯ ◯ ◯ ◯ ◯ Strongly Agree

ECONOMIC FACTORS

This survey focuses on understanding the impact of the Delhi-Mumbai Industrial Corridor (DMIC) on economic factors such as employment, income levels, and poverty in your area.

1. Total monthly household income (approximate):
   - ☐ Less than ₹5,000
   - ☐ ₹5,000–₹10,000
   - ☐ ₹10,000–₹20,000
   - ☐ ₹20,000₹50,000
   - ☐ > 50,000

2. To what extent has the development of industrial corridor created employment opportunities in your area?

1 2 3 4 5

Worsened Significantly ◯ ◯ ◯ ◯ ◯ Improved Significantly

3. Has your household been able to save more or improve financial security due to economic growth in the region?

1 2 3 4 5

Not at all ◯ ◯ ◯ ◯ ◯ Significantly

4. Do you believe that DMIC has positively impacted the economic condition of your household?

	1	2	3	4	5	
Worsened Significantly	◯	◯	◯	◯	◯	Improved Significantly

5. Has the local economy experienced growth due to DMIC projects (e.g., new businesses, higher wages)?

	1	2	3	4	5	
Worsened Significantly	◯	◯	◯	◯	◯	Improved Significantly

6. To what extent has DMIC-related development attracted investments or businesses to your area?

	1	2	3	4	5	
Worsened Significantly	◯	◯	◯	◯	◯	Improved Significantly

INFRASTRUCTURE

This survey aims to assess the impact of the Delhi-Mumbai Industrial Corridor on infrastructure development, particularly water, sanitation, and electricity facilities, in your area.

1. Type of Residence

- ☐ Permanent house
- ☐ Semi-permanent house
- ☐ Temporary house

2. Main source of household water

- ☐ Piped water
- ☐ Community well
- ☐ Borewell
- ☐ Tanker Supply
- ☐ Others_____

3. The water supply in the household is reliable and consistent.

1	2	3	4	5
◯	◯	◯	◯	◯

Strongly Disagree Strongly Agree

4. The quality of drinking water available to the household

	1	2	3	4	5	
Very poor	◯	◯	◯	◯	◯	Excellent

5. Has the development of DMIC-related infrastructure improved water supply in your area?

	1	2	3	4	5	
Worsened Significantly	◯	◯	◯	◯	◯	Improved Significantly

6. The community sanitation infrastructure (e.g., waste disposal, drainage) is adequate.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

7. Have sanitation facilities in your area improved due to DMIC-related development?

	1	2	3	4	5	
Worsened Significantly	◯	◯	◯	◯	◯	Improved Significantly

8. Are open drains or improper waste disposal a persistent issue in your community?

	1	2	3	4	5	
Very frequent issue	◯	◯	◯	◯	◯	No issue

9. The electricity supply in your household is reliable and consistent

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

10. Has the electricity infrastructure improved in your area due to DMIC-related projects?

	1	2	3	4	5	
Worsened Significantly	◯	◯	◯	◯	◯	Improved Significantly

11. Are the electricity charges affordable for your household?

	1	2	3	4	5	
Not affordable	◯	◯	◯	◯	◯	Affordable

DEMOGRAPHICS

1. Age distribution of household members:

- ☐ Below 18 years
- ☐ 18–35 years
- ☐ 36–60 years
- ☐ Above 60 years

2. Number of senior citizens (above 60 years) in your household

_____

3. Main reasons for migration in your household

- ☐ Employment opportunities
- ☐ Education
- ☐ Better living conditions
- ☐ Marriage
- ☐ Other

4. How common is inward migration in your area due to DMIC-related opportunities?

	1	2	3	4	5	
Very uncommon	◯	◯	◯	◯	◯	Very Common

5. To what extent has outward migration from your area decreased due to DMIC-related development?

	1	2	3	4	5	
Significant Decrease	◯	◯	◯	◯	◯	No Decrease

6. Are migrant workers in your community provided with adequate housing and basic services?

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

7. Do you think the influx of migrants has positively contributed to the local economy?

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

8. Are public services (e.g., healthcare, schools) in your area equipped to handle the increase in population due to migration?

	1	2	3	4	5	
Not Equipped	◯	◯	◯	◯	◯	Fully Equipped

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